Vol. XXVII. Part 11.

[Registered at the General Post Office, Melbourne, for transmission by Post as a Newspaper.]

The Journal of the Department of Agriculture of Victoria, Australia.

Nov., 1929.

PRINCIPAL CONTENTS

Modern Wine-Making Methods
Success in Dairy Farming
The Economic Use of Irrigation Water
Rhizoctonia Disease in Potatoes
Spraying Costs in Codling Moth Control
Champagne
Sheep Diseases
Potato Manurial Trials

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THE JOURNAL

OF

THE DEPARTMENT OF AGRICULTURE,

VICTORIA, AUSTRALIA.

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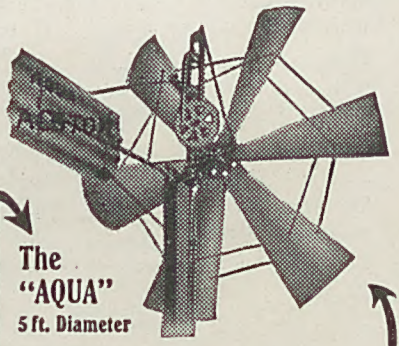

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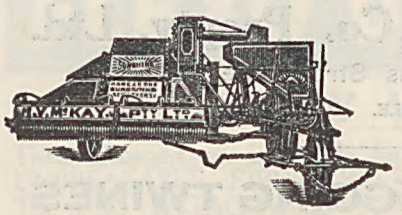

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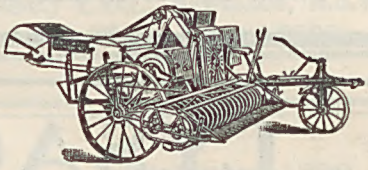

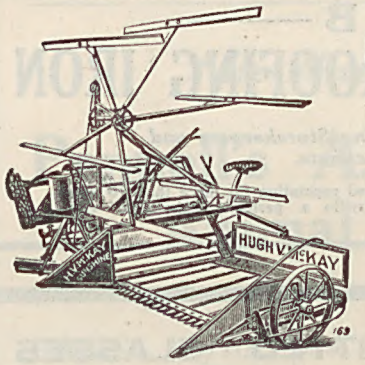

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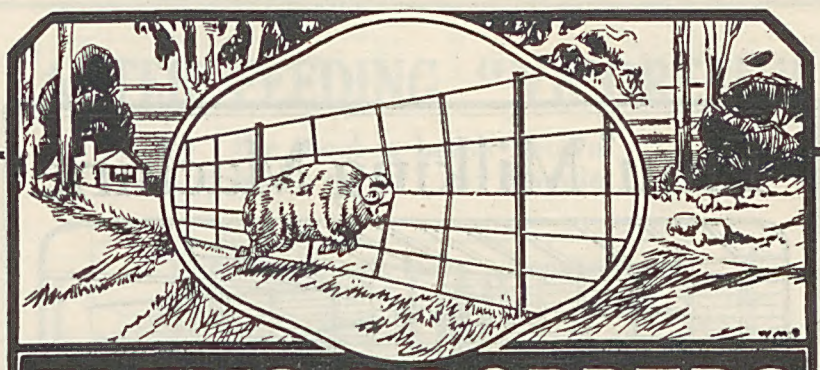

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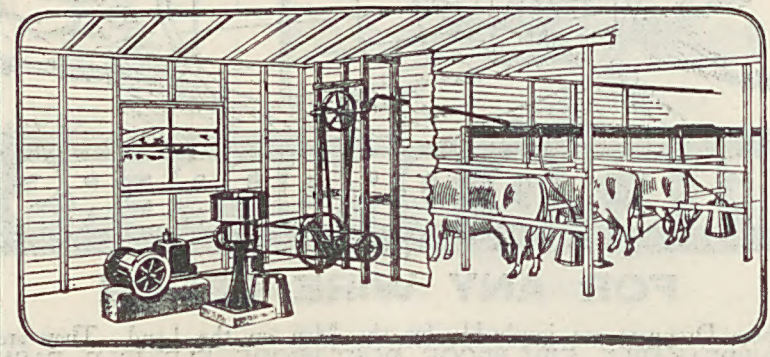

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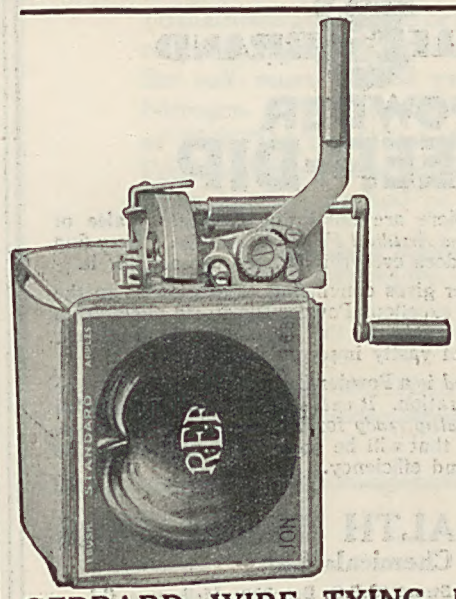

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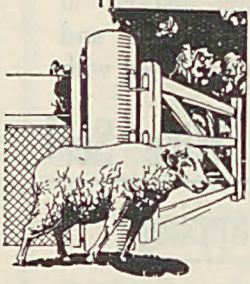

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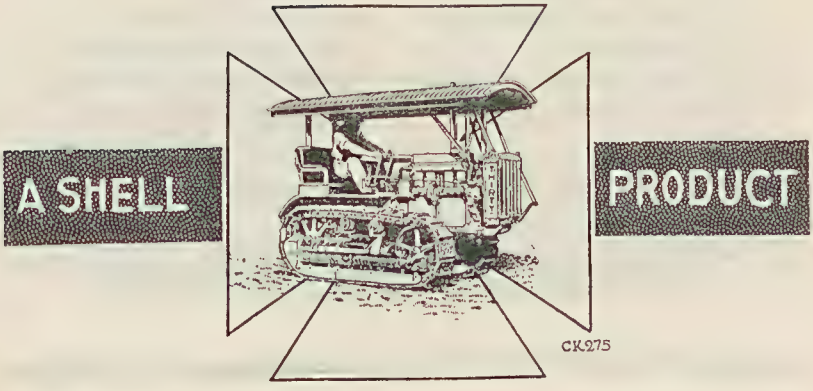

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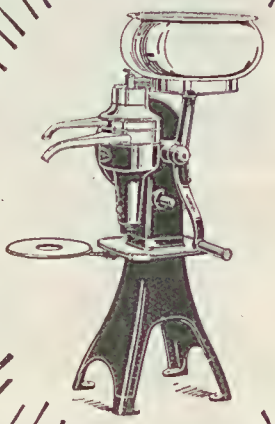

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THE JOURNAL

OF THE

Department of Agriculture

OF

VICTORIA.

Vol. XXVII. November, 1929. Part 11

SUCCESS IN DAIRY FARMING.

FINE RESULTS IN SOUTH GIPPSLAND.

By W. J. Yuill, Senior Dairy Supervisor.

If there were any royal road to success in dairy farming, one would be inclined to say that this hidden way had surely been found by the Messrs. Smith Brothers, whose farm, Sylvan Hills, at Mirboo North, is in the heart of the South Gippsland hill country. Yet few people seeking that royal road would choose such country as the scene of their search, for here there are many adverse circumstances to contend against. The district, however, has one outstanding condition, and that is a high yearly rainfall, and the Smith Brothers take every advantage of that rainfall. It is their practice to fallow an extensive area every year, and in this way conserve moisture, so that abundant fodder crops can always be relied on.

There is no mystery about the success of the Messrs. Smith Brothers; they possess a sound business sense, and by rigorous culling of all cows below a certain standard, they have built up a herd which gives as great a return as is in many cases only derived from a herd of twice the size.

Great Development in Production.

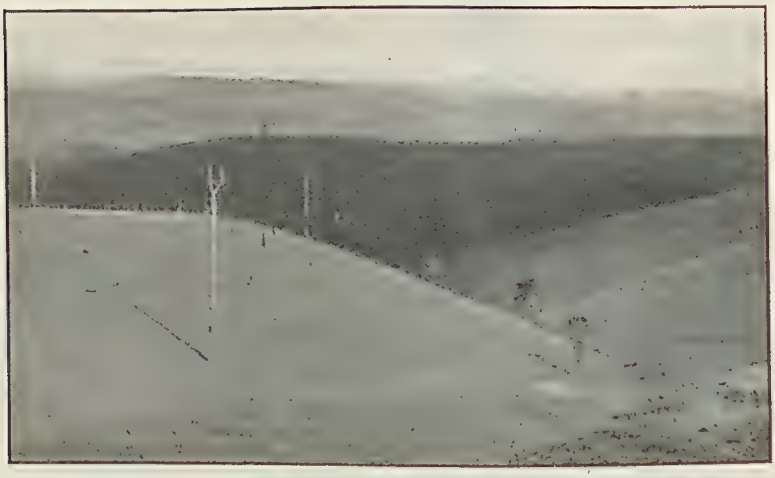
To develop a 400-lb. butter-fat standard in seven years is a fine achievement, even under the best conditions, and when all the members of the herd are mature. But to have done so in rough, hilly country with a herd in which three-fifths of the cows were under five years is indeed a record. At the present time the herd consists of eight two-year old heifers, three three-year-olds, four four-year-olds, and ten mature cows.

In the 1928-29 season, there were a number of herds in the Victorian United Cow Testing Association that failed to average 150 lb. of butter-fat per cow. During the seven years that the Smith Brothers' herd

has been under test, the average production per cow has been increased by 181 lb. The improvement made in the returns from the herd up to the 1928-29 season is indicated hereunder:—

Year.	Number of Cows in Herd.	Average Yield per Cow.	Financial Return per Cow.
			£
1922–23	30	223	16 10/-
1927–28	26	370	27
1928–29	25	404	30

If last year's total cost of bran, of superphosphates for pasture and crops, of seed grain, and of minerals for licks be debited against the dairy herd the amount works out at £4 5s. per cow.



Steep Bracken-covered Hill Country can be turned into Excellent Pasture Land by concentrated efforts with the Bracken Cutter.

Two years ago this paddock was a jungle of bracken and undergrowth; to-day it is the best pasture on "Sylvan Hills" farm.

Factors that Lead to Success.

In order to attain success in dairying, one must arrange affairs in such a way that there will be sufficient feed for every cow for each of the 365 days of the year. The Messrs. Smith Brothers are relieved of any anxiety on this score by the growing of fodder crops over a long period of the year. When the herd is being extensively fed on cereals such as oats or millet, either in the green or in the hay stage, the Smith Brothers consider the addition of mineral matter essential, and about 2 oz. per day is added to each cow's bail ration. If for any reason the continuity of the green fodder allowance cannot be maintained, its place is taken by some form of concentrates, so that the milk flow will not be reduced.

Careful feeding of dairy cows is as necessary during the "rest" or dry period as when they are in milk. After the autumn rains the Smith Brothers always reserve a well sheltered paddock in which to winter their dry cows.

Only three members of the herd that was being milked when Messrs. Smith Brothers took over are still on the farm. This indicates how rigorously the herd has been culled. As better young cows have become available, the old ones have been disposed of. The wisdom of getting a bull from a "high production" family has always been recognized.

The original herd was of milking Shorthorn stock. On this foundation, four top crosses of the Jersey breed have been used. Golden Spark VII. was the first bull obtained. He was followed by Reynard's Pride, *ex* Lobina's Lady, an 870-gallon cow, with a record of 486 lb. of butter-fat. The progeny of this bull proved to be exceptional producers, several exceeding the 500 lb. mark.

One of the Originals.

Beauty, dam of twenty calves. She is now 22 years old, and last year she produced over 400 lb. butter-fat.

Although these cows were such fine producers, several were rather coarse and plain, and showed little "blend" in the conformation character.

Most of the present herd have been sired by Butterwinks II. of Jersey Hill, whose dam, Tiddlewinks II. of Holmswood, was champion producer in the Standard Test in 1919. The record of this cow (she was a double cross Audrey Lord Twylish cow) was 578 lb. of butter-fat.

The progeny of Butterwinks show greatly improved conformation, as well as a substantial lift in production. Sixteen of his daughters on their first and second calf averaged 342 lb. of butter-fat. Recently, several of his two-year-old grade heifers, springing on their first calf, were sold at auction for £21 each. All of them were purchased by members of Herd Testing Associations.

The present stud bull is Heir Apparent of Somerville, *ex* Northern Queen of Somerville, and he is by Repulse of Somerville, whose dam was Bobs of Somerville, the highest producer of this State. Her yield of 843 lb. of butter-fat in 273 days is a record for the Empire for a four-year-old Jersey cow.

Production Character is Developed in the Progeny of Grade Cows as well as Pure Breds.

The owners of Sylvan Hills have found that the development of the "production" character in the progeny of the selected grade cows has been at least equal to that of the progeny of the pure-bred cows—in some cases considerably better. This is best shown by a comparison of the production records.

Some years ago several pure-bred cows were purchased. One of these —Duchess 4th of Goulburn, by Rufus of Melrose, by Pretty Noble (impt.)—has proved an excellent investment. During the last seven

Beauty, 4-year-old (Twin). Alma, 5-year-old. Lily, 4-year-old (Twin).

Typical "Butterwinks" Heifers ex Duchess 4th of Goulburn.

years she has produced eight calves (including twin heifers); five of these are members of the present milking herd. There are now on the farm eighteen females descended from this fine foundation cow (including seven heifer calves this season). The record of Duchess 4th of Goulburn for the past four seasons is given below:—

Year.	Age.	Milk.	Test.	Butter-fat.
		lb.	%	lb.
1925–6	5	5,272	6.49	342
1926–7	6	9,406	6.34	596
1927–8	7	7,410	6.21	460
1928–9	8	10,498	6.11	645

In 1928, Duchess calved "in milk." This very materially reduced her yield for that season. A remarkable fact about this cow's production is that she has produced 1,710 lb. with only one rest period. A feature of her record is the high average test. This characteristic.

together with her ability to remain in milk over a very long period, seems to have been passed on to her daughters. The record of four of these daughters, all by Butterwinks, are given below:—

Name.	As Junior 2-yr.-old.			As Senior 2-yr.-old.			As 3-yr.-old.			As 4-yr.-old.		
	Milk.	Test.	Butter-fat.	Milk.	Test.	Butter-fat.	Milk.	Test.	Butter-fat.	Milk.	Test.	Butter-fat.
	lb.	%	lb.	lb.	%	lb.	lb.	%	lb.	lb.	%	lb.
Fairy ..	3,850	6·36	244	3,135	5.87	302	5,141	6.60	340	6,922	6.83	473
Alma ..	..	..	..	5,299	5.48	291	6,938	6.19	429	..	..	..
Lily I. ..	4,440	5.45	242	4,924	5.76	288	6,658	5.9	393	..	..	..
Daisy I...	4,189	6.78	284	5,152	6.46	333	2,833	6.01	174	..	..	..

A daughter of Lily I., calving at 23 months, produced 327 lb. of butter-fat in 273 days.

A comparison of the records of these daughters of Duchess, and of the progeny of some of the high production grade cows, reveals the prepotent character of Butterwinks, for his daughters are equally good in both instances.

Lemon. Nuggett. Kate. Darkie.

Grade Daughters of Reynard's Pride.

Lemon averaged 438 lb. butter-fat for three years.
Nuggett was the first cow on the farm to produce 400 lb. butter-fat in one year.
Kate has on two occasions produced over 500 lb. butter-fat in a year. Her average for three years is 486 lb.
Darkie produced over 500 lb. butter-fat as a 4-year-old.

Nuggett, Kate, and Lemon are daughters of Reynard's Pride, and were bred from some of the best cows in the original herd. Nuggett was the first cow on the farm to reach the 400-lb. standard. Darkie and Nuggett II. are full sisters, both being daughters of Nuggett, by Butterwinks.

RECORDS OF DARKIE AND NUGGETT II.

Name.	As Junior 2-yr.-old.			As Senior 2-yr.-old.			As 3-yr.-old.			As 4-yr.-old.		
	Milk.	Test.	Butter-fat.	Milk.	Test.	Butter-fat.	Milk.	Test.	Butter-fat.	Milk.	Test.	Butter-fat.
	lb.	%	lb.	lb.	%	lb.	lb.	%	lb.	lb.	%	lb.
Darkie ..	4,745	5.45	259	..	..	..	6,732	6.01	405	8,421	6.15	518
Nuggett II.	..	..	..	6,713	5.75	353	..	..	..	..	..	..

Kate, who was bred from the best grade cow in the original herd, is now the best grade cow. It is interesting to note how the character for production has been intensified by Reynard's Pride, and again by Butterwinks. Darkie's record for the past four years, as given hereunder, shows her to be a very fine producer:—

Year.	Milk.	Average Test.	Butter.	Milk, Last Day of Test.
	lb.	%	lb.	lb.
1925-6	6,696	5·41	379	17
1926-7	7,456	5·30	406	13
1927-8	9,358	5·46	512	22
1928-9	9,606	5·59	538	21

Hereunder are the records of Judy and Kitty, both daughters of Kate, by Butterwinks. The record of Kitty must undoubtedly have been remarkable had she not failed to be put in calf:—

Name.	As Junior 2-yr.-old.				As Senior 2-yr.-old.				As 3-yr.-old.				As 4-yr.-old.			
	Milk.	Test.	Fat.	Milk on Last Day.	Milk.	Test.	Fat.	Milk on Last Day.	Milk.	Test.	Fat.	Milk on Last Day.	Milk.	Test.	Fat.	Milk on Last Day.
	lb.	%	lb.	lb.	lb.	%	lb.	lb.	lb.	%	lb.	lb.	lb.	%	lb.	lb.
Judy	5,321	5.51	293	9	6,721	5.12	345	10	8,138	5.86	477	26	8,512	5.52	487	22½
Kitty	..	..	..	..	9,018	5.67	511	20	..	..	..	..	..	..	..	..

Lemon has proved a very consistent producer. Her four records as a mature cow average 7,575 lb. milk, with a 5.78 test, equalling 438 lb. of butter-fat. Her average yield of milk on the last test day in each of the four years was 16½ lb.

Peggy is a daughter of Lemon, and is by Reynard's Pride, and is therefore by her own dam's sire. Sally and Lemon II. are *ex* Lemon, but are by Butterwinks. The records of these two cows are as follow:—

Name.	As Junior 2-yr.-old.			As Senior 2-yr.-old.			As 3-yr.-old.		
	Milk.	Test.	Butter-fat.	Milk.	Test.	Butter-fat.	Milk.	Test.	Butter-fat.
	lb.	%	lb.	lb.	%	lb.	lb.	%	lb.
Peggy ..	4,509	5.15	233	5,751	5.07	288	7,183	5.43	391
Lemon II. ..	..	..	..	8,226	4.32	355	..	..	..
Sally ..	7,140	4.76	340	..	..	..	..	..	..

Lemon II. is owned by Mr. W. G. Griggs, of Hallston, while Sally is owned by Mr. A. McPhie. Sally, as a junior two-year-old, held first place in the Mirboo District Herd Test Association.

In comparing the yield of the daughters of Butterwinks, it is interesting to find that daughters of the high-grade producers surpass the records of the pure-bred by a fair margin.

If the record of Kitty, the grade heifer, and that of Daisy I. be excluded because of abnormal conditions, it will be found that the yields of the grade daughters exceed those of the pure breds by 55 lb. each.

	Butter-fat. lb.
(1) Pure-bred daughters—11 lactations, average yield ...	329
(2) Grade daughters—10 lactations, average yield ...	384
Difference in favour of grades	55

It is not by any means uncommon to find that the pure-bred "production" bull will exert a greater influence on grade or even common cows than on pure-bred females. This is the best proof that the "production" characteristic is inherent in him.

A Grade Daughter of Reynard's Pride—Nuggett, a Typical Dairy Cow.
She has averaged over 400 lb. butter-fat for several years.

It is this fact that makes the sons of consistently high-producing pure-bred cows the hope of the industry, for by them we can hope to broadcast through our grade herds the "production" character, and as the better bred dairy cows become more common, the onus will be upon the farmer to see that the inefficient members of his herd are culled, and their places taken by animals from which high yields are possible.

Feeding Methods.

The pastures on Sylvan Hills are not good, consisting mainly of Danthonia or wallaby grass. Because of the short season of good grazing for the dairy herd, it has been found necessary in winter and early spring to supplement the pasture feed with oaten hay; during summer and autumn Japanese millet is the supplementary feed.

About 30 acres of Algerian oats are sown annually to provide hay for all stock.

The cows that calve early are grazed on the hay crops until September, when the paddocks are closed up. During this time each cow receives

Duchess 4th of Goulburn and four of her Daughters by Butterwinks I. of Mt. Eccles.
There are seven females on the farm descended from this cow, now 9½years old.

a daily allowance of two kerosene tins of chaff, and a few lb. of bran; with the chaff about 2 oz. of mineral mixture is fed. This feeding is continued until the pastures give sufficient nourishment.

The Messrs. Smith Brothers consider that the feeding of hay to dairy cows is the most profitable use to which it could be put. They say that if they were to sell it as chaff, it would not return a profit of more than £1 per ton.

Some would, perhaps, be inclined to recommend that, on a dairy farm, more clover and pasture hay should be grown, but in view of the very great success attained at Sylvan Hills, one is hesitant to make any suggestion.

It is always planned to have Japanese millet available where the pastures begin to " go off " early in the new year. Should the millet be backward, bran is again resorted to in order to maintain the milk flow. If once the milk flow declines, it is very difficult to bring it back again to the former level.

The quantity of Japanese millet which the Smith Brothers recommend for districts such as theirs is at least an acre for each cow. The seed is usually drilled in about the third week in October. Approximately, 20 lb. of seed and 1 cwt. superphosphate per acre are allowed. No pains are spared to prepare a well worked seed-bed. Usually the crop furnishes good grazing from the second week in January until well into May.

A secondary reason given by Messrs. Smith for growing Japanese millet as extensively as they do is that they desire to break up the whole of the wallaby grass area on their farm, and re-sow it with a mixture of cocksfoot, rye, and clover.

The Smith's farm originally consisted of 311 acres. Some time since, however, an adjoining area of 176 acres was taken over, and in two years was entirely reclaimed. Before the work was undertaken, there was an almost impenetrable jungle of ferns, bracken, and weeds, as well as an overgrowth of hazel and scrub, in which vermin of many kinds abounded.

A splendid " burn off " left a good seed-bed, on which 17 lb. of cocksfoot, 11 lb. of rye, and 1 lb. of white Dutch clover was sown per acre. All the rabbit burrows have been dug out, the logs burnt, and the bracken has been practically eradicated.

The cost of bringing this abandoned area back to profit is set down at about £5 per acre for labour. The main labour cost was for cutting bracken. It had to be cut nine times during the first year, for the only hope of eradicating it is to cut the young plants as soon as the " buds " or fronds appear.

This land is now considered to afford the best pasture on the farm, and since the second year after re-sowing it, the dairy cows have apparently preferred the feed grown on it. Thus a valuable area now takes the place of a scrubby, rabbit-infested area, and there is a great deal of country in the South Gippsland hills that could be similarly reclaimed.

The farm is valued at about £16 per acre. Last year, 69 bullocks were fattened there, and, in addition, the dairy herd of 25, and another 20 head of stock and seven horses were run on it. Thus it carried one head to 4 acres, or 1½ head on each £100 worth of land.

The Messrs. Smith warmly testify to the worth of the work done by Herd Test Associations. They claim that continuous test work is essential in order to observe the development of the various families

in the herd, as well as to secure the earliest possible information regarding the value of stud bulls.

Mr. George Smith is one of the foundation members of the Mirboo District Herd Test Association, and is now president of that body.

INFLUENCES THAT HAVE MADE FOR SUCCESS.

The Messrs. Smith assert that the great influence in their success has been derived from the lessons learned from their pioneering parents. It may be asked what are the chief factors that have helped to increase in a few years the returns from the dairy herd by £15 per head. Perhaps they may be summarized as follows:—

(1) Abundant supplies of green fodder.
(2) The use of the best "production" pure-bred bulls.
(3) The maintenance of the milk flow by the judicious use of concentrates.
(4) The use of a mineral mixture when cereals are being extensively used.
(5) Development of better pastures.
(6) Regular top-dressing of pastures.
(7) The testing of milk and recording of yields regularly and continuously from year to year.
(8) The provision of a good water supply easily available to the herd.
(9) The feeding of hay (the growing of which would be otherwise unprofitable) to the dairy cows.

FRUIT RELEASES HEAT IN THE REFRIGERATOR.

Which would require the larger piece of ice to keep it cool, a 10-lb. roast of beef or 10 lb. of ripe peaches? Most people would think this a silly question, and would answer that the meat demands better refrigeration. That, however, is not precisely the question, says the United States of America Department of Agriculture. Once the meat is thoroughly cooled, the only task for the ice in the refrigerator is to absorb the heat that may leak in from the warmer outside air. If the temperature is low enough to prevent decay or mold formation, the meat, not being alive, creates no heat within the refrigerator.

The peaches, as a rule, present a different case. The peaches, however, are living. Physical and chemical changes are in progress. The fruit is respiring. It is taking up oxygen and is liberating carbon dioxide and water formed by the oxidation of its sugars. This chemical process is accompanied by a production of heat, and the heat would melt some ice in the refrigerator which would not be melted if the meat roast were substituted and kept at the same temperature as the peaches.

MODERN WINE-MAKING METHODS.*

By F. de Castella, Viticulturist.

As my contribution to this tenth annual congress, I think it may not be inopportune to briefly review the innovations that distinguish the oenology of to-day from that of half a century ago, more particularly devoting attention to a few recent wine-making developments. The subject is too vast for comprehensive treatment. It is not my intention to inflict on you even a skeleton treatise of oenology. In the space to which I must confine myself I propose to touch on a few directions in which I think we can usefully modify or supplement the practices now usual in our wineries.

Pasteur's discoveries and those of the scientists who followed in his footsteps have not alone transformed wine-making, but they have built up the science of biology, with all its ramifications and far-reaching consequences. No single man has so revolutionized human activities as did Pasteur, when by tearing away the veil that previously hid the mysteries of fermentation, and by demolishing the spontaneous generation hypothesis, he opened up new vistas to scientific thought.

We should be proud to think that the investigations which first proclaimed his master mind were in connexion with the industry with which this assemblage is so intimately concerned. We can take further comfort from the knowledge that the great Pasteur was altogether in sympathy with our industry. Did he not pronounce wine to be the most wholesome and most hygienic of beverages?

His discoveries are of even greater importance to us in warm Australia than to wine-makers in many old-world wine districts. In the cooler regions of Europe wine practically makes itself. Crushing the fruit places the juice in contact with the yeast spores on the outside, permitting the purpose of Providence to be fulfilled and the juice to be converted into wine. In privileged regions such as the Medoc of Bordeaux, the juice is usually of ideal composition, the bloom contains a perfect yeast, the functions of which are exercised under the happiest conditions of temperature, &c., and a perfect wine results. What could be better than a Chateau Margeaux '48 or a Chateau Lafitte '69? Nothing of later years has been able to surpass them in excellence, and yet oenology had not then profited by the discoveries of science.

But in other regions less favoured by nature, things did not always pass under such happy auspices. In warm Southern Europe deficient acidity and high fermentation temperatures sometimes resulted in faulty wines, unless recourse was had to certain practices such as the plastering once so common in Southern France and Spain, and the addition of pine resin still practised in Greece. Plaster and resin played the same part that the hop does in brewing. With their aid a sound wine could be made in spite of adverse conditions. But such auxiliaries are now ancient history.

Plastering, which, by the way, has never been resorted to in Australia —not even in the bad old days before we got pure wine legislation—was long since condemned by the French Academy of Medicine, and eventu-

* Paper read at the Tenth Interstate Wine Congress, Sydney, October, 1929.

ally superseded by other practices, notably, within the last 20 years, by sulphiting, with the happiest results.

The directions in which oenology has been transformed may be outlined as follows:—

We now conduct our fermentation in cement vats instead of the wooden ones of former days, their greater heat conductivity reducing the risk of dangerous temperatures. Direct temperature control by attemperators is also a regular practice. There is, no doubt, a tendency in many quarters to supersede this by the indirect chemical or more correctly physiological temperature control, with sulphur dioxide—perhaps too much so.

We correct the composition of our musts, when defective, by such means as the addition of tartaric acid or by the blending in of other grape sorts, and, in the case of white wine, by the addition of tannin.

We ferment our wines by means of pure yeast capable of giving a definite result, and more reliable therefore, than the spontaneous fermentation by the yeast provided by nature, which may be, but sometimes is not, all that could be desired.

We control the course of fermentation by sulphiting—in other words, by the selective antiseptic action of SO_2 which inhibits undesirable micro-organisms to a greater extent than the good yeast. This, the only antiseptic allowed in wine making, has the precious quality of being only temporarily present in the wine. It is eliminated after it has done its useful work.

We stimulate the action of yeast when this is necessary by the addition of small quantities of ammonium phosphate in much the same way as we increase the growth of higher plants with artificial manures.

If, later on, in spite of all precautions during the earlier operations, wine disease organisms should succeed in contaminating our wines, we have in pasteurization a potent means for their elimination. Filtration has been vastly improved. Filters are now available that permit the elimination of undesirable organisms to an extent almost equivalent to pasteurization.

The mechanical equipment of our wineries has also seen transformations. The must pump has largely superseded the elevator and gravitational systems. The continuous press, by its more economical working, ousted the old screw presses, but it is in turn being superseded by the hydraulic, which presents marked advantages in the way of absence of stalky taste, enormous reduction in the proportion of lees at first racking and young wines that not only become limpid earlier but subsequently maintain their condition much better. Mention must here be made of the Algerian automatic washer vat, though it has not yet been tried in our wineries.

Lastly, we have stringent pure wine legislation, in connexion with which there is a gratifying tendency towards uniformity in the different States.

Wine is defined in the Victorian Health Act as "the product solely of the alcoholic fermentation of the juice or must of fresh grapes." The objects of these laws are:—

(1) to ensure the correctness of the above definition;
(2) to ensure that the wine be sound and free from adulteration;
(3) to prevent the patching up of faulty wines with a view to rendering them merchantable.

Though possibly capable of improvement in some directions, this legislation has been welcomed by all honest wine makers, whom it protects from the competition of unscrupulous manipulators. It is precious as a vindication of the purity of our wines, and an irrefutable answer to those would-be mentors who are only too ready to impugn it.

Most of this is familiar to all wine-makers. These methods are so well established that their discussion at any length would here be out of place. I shall therefore limit my remarks to a few aspects which I think can, with advantage be gone into more fully.

New Wine-Making Methods.

Several of these were reviewed by the writer in an article that appeared in this *Journal* for January, 1922, dealing principally with the method known as preliminary maceration. A reprint of this is available for any one interested. In addition to this method, heat extraction, Barbet's vinerie system, Semichon's deferred maceration method, and continuous fermentation are also outlined.

Preliminary maceration consists in the partial sterilization of the crushed grapes by the addition of about four times the normal dose of sulphur dioxide, or 6.4 ounces of SO_2 to 100 gallons. Fermentation is held up for four days, during which maceration takes place, colour and tannin being dissolved from the skins during the process. On the fourth day the grapes are pressed and the must fermented, just as in white wine-making. Fermentation is slow at first, but continues satisfactorily, the SO_2 being mechanically carried off by the escaping bubbles of CO_2. The colour, which was at the first a good deal bleached, resumes its intensity as the SO_2 is eliminated.

The method is satisfactory for dry wine-making, especially in very hot weather, the deferred fermentation and its lesser activity much reducing risk of dangerous temperatures. We have during the past six years applied the preliminary maceration method at the Rutherglen Viticultural Station on a commercial scale, with very satisfactory results. Though the advantages may not be so striking in a normal season, the method would prove precious should a heat wave occur during vintage, by avoidance of unsound wine and consequent invasion of the winery by countless wine disease germs. It applies more particularly to dry wine, and seems less suited to the making of sweet wine. A modification of this method by using half the dose of SO_2 seems worthy of trial. Fermentation would then progress to a slight extent during the four days' maceration.

Continuous Fermentation.

This has proved altogether satisfactory in industrial distilleries. Its application to wine-making has been strongly advocated, notably by Semichon. Briefly, this consists in making withdrawals, either continuously or at frequent intervals, from the fermenting vat, and simultaneously replenishing it with cold sulphited must; the portions thus withdrawn completing their fermentation in special finishing vats. In this way the gravity of the main fermenting vat is kept practically at the same point during the whole course of fermentation—usually in the neighbourhood of 5° or 6° Baume. The main advantages are facilitation of temperature control, a better alcohol yield, and the making of large quantities of wine of very even type.

The Super-Seven Method.

Known in France as "La Methode Superquatre," which a golfer would no doubt translate as the plus-four method, this merits more detailed examination, as it may have important consequences in Australia. It is a logical outcome of continuous fermentation, and simply consists in so conducting the progress of fermentation that, from its very commencement, the alcohol strength of the medium is not lower than 4 per cent. of absolute alcohol by volume, equivalent to 6.99 per cent. proof—say 7 per cent. The derivation of the name I have supplied is thus obvious.

The advantages of such a course are not very clear unless we consider what happens in the ordinary spontaneous fermentation of grape juice. We know that the bloom on the skin of the berry contains spores of many micro-organisms. The first to develop are the common moulds—*Dematium, Cladosporium, Mucor, Botrytis,* &c. The next to start are *Saccharomyces apiculatus* and other wild yeasts It is only later on that the true wine yeast, *Saccharomyces ellipsoideus,* takes charge. The moulds being essentially acrobic, only develop on the surface. Though a submerged life is possible for them, their multiplication in this way is unimportant. Not so with the wild and apiculate yeasts, especially the latter, which literally swarm in the first stages of a spontaneous fermentation.

The resultant alcohol is the selective agent that decides the preponderance of different organisms at different stages of the process. Moulds are soon eliminated, even if they did succeed in obtaining a footing. They cannot withstand more than 2.5 per cent,. of alcohol (4.36 proof). Wild and apiculate yeasts are more tolerant. They can exist up to a strength of 5 per cent. absolute, or 8.7 proof. Though they cannot obtain a footing if the initial strength be over 7 per cent. proof.

In a spontaneous fermentation they cease to multiply actively when the strength nears 7 per cent. proof and the ellipsoid or good yeast at last gets its innings. Alcohol is thus an agent of physiological selection, which can enable us to entirely eliminate moulds and undesirable yeasts, wild or apiculate. These last are undesirable in various ways. They are sugar or alcohol wasters, and result in a lower alcohol strength in the finished wine. They are responsible for undesirable flavours and odours. The *Gout de Terroir,* or earthy taste, for example. Mr. Hagelgrove told us at Rutherglen in 1925 that Bouffard and Ventre were of opinion that mousiness is due to a yeast, though of what type has not yet been determined. I was told at Jerez that the Oloroso sherries largely owe their character to the apiculate yeast. In the majority of cases, however, it is decidedly to our advantage to eliminate all yeasts, in fact, all organisms other than the good ellipsoid yeast.

Even if we use a pure yeast we are not assured of its conducting the whole of the fermentation. Unless the vat be pitched with a massive dose of pure starter it is more than probable that in the early stages apiculate and wild yeasts are actively at work, the added yeast only obtaining the mastery later on in the process.

The practical application of the super-seven method is simple—the essential is that no fermentation should start until the alcohol strength of the medium is 7 per cent. proof.

In the case of white wine it is merely necessary to pump into the fermenting vat one-third of its capacity of wine containing 21 per

cent. proof, and to fill it up with must from the press; and so on in similar manner with the other vats. For the first vat of the season it is obviously necessary to commence with old wine. This need only be a small vat, and a start can be made with it a few days before vintage commences in real earnest.

In the case of red wine the vat is filled in the usual way, but one-third of the juice is drained off and immediately replaced by a wine containing at least 21 per cent. proof spirit. The part that has drained off is likewise mixed with one-third of its bulk of already made wine and allowed to ferment.

In the south of France where 8° and 9° Baume musts are the rule the wine and must are blended in equal proportions. With our fuller-bodied wines one part of wine to two of must would achieve the requisite initial strength of 7 per cent. proof.

The method is admirably adapted for the use of pure yeasts, which are indeed almost indispensable for the first vat of the season in which old wine is blended. The wine contains no yeast, and the ellipsoid yeast is scarce on the fresh grapes. Later on the new wines contain ample yeast cells.

Semichon resumes the advantages of the method as follows:—

1. Pure alcoholic fermentation guaranteeing stability and keeping qualities.
2. Development of the "taste of fruit,"* of roundness and delicacy.
3. Elimination of bad tastes and bad odours, consequences of impure fermentations.
4. Gain in alcohol and in natural fixed acidity.
5. Very easy working and great regularity of fermentation, with marked saving in cellar plant.

The method has recently been applied on a large scale in southern France. The increase in alcohol strength is estimated at from .5 to .9 per cent. absolute or 1 to 1½ per cent. proof, with a marked improvement in quality, the wines being more easily saleable than those made in the ordinary way.

One large grower comments on the absence of the roughness usually characteristic of young wine made from Terret-Bourret grape.

In the making of our sweet wines the super-seven method should be of easy application. These wines must of necessity be fortified. Why not add the spirit, or at least enough of it to bring the strength to the desired 7 per cent. proof, before the start of fermentation? To sweet white wines more especially does this apply.

With red sweets a small portion of the spirit would be retained by the marc; though recoverable by distillation, as is usual in up-to-date wineries, the excise paid on this spirit would be sacrificed unless its refund could be arranged with the Customs Department.

Another question presents itself. Does the apiculate yeast play a useful part in a sweet wine though undesirable in dry wine. The *rancio* character may indeed have some connexion with it. These are points to be tested under our conditions. The importance of the method in light dry wine-making—and I should like to see the consumption of our light wines enormously increased—is my excuse for devoting so much time to it.

* This is quite distinct from fruitiness or slight sweetness. A perfectly dry wine can present taste of fruit; it is a quality greatly appreciated by connoisseurs.

The Algerian "Automatic Washer" Vat.

This method certainly merits brief description. It is on the same principle as the automatic clothes washers sometimes used, in which a central tube permits the rise of the boiling soapy water more easily than the bubbles of steam can effect their passage through the mass of clothes that surrounds the tube.

The soapy water falls back on these clothes, over which it is evenly distributed by a special arrangement at the top of the tube. Thus is set up a circulation that continues so long as the soapy water is on the boil.

In the Algerian vat the steam is replaced by the carbon dioxide resulting from fermentation and the "washing" by the marc. In other respects its functioning is similar, but the arrangement is necessarily different.

The Algerian vat is a double one. More correctly, it consists of two superposed vats. The larger lower one is closed by a broad dome-shaped top. It communicates with the smaller upper one, about one-seventh of its capacity, by a circular opening about 2 feet in diameter in the top of the dome. Into the centre of this opening is fitted a vertical tube of wood or copper, about 5 inches in diameter, which reaches from the bottom of the large vat to just about the level of the bottom of the small vat. This tube is perforated at its base and is slightly tapering, the base end being narrower.

As soon as the lower vat is completely filled, a wooden grating made in two parts and a little larger than the aperture, is fitted round the vertical tube, just below the top of the larger vat. This grating prevents the rise of the marc and, opposing some resistance to the passage of bubbles of CO^2, it causes the liquid to rise through the central tube into the smaller vat. Its own weight forces it back through the marc, which is thus effectually washed by it. In this way a circulation is set up which continues during the active fermentation period.

The advantages claimed are—

1. More complete colour extraction.
2. No danger of acetic fermentation.
3. Moderate aeration of the yeast cells in the liquid forced into the upper vat.
4. More satisfactory temperature control; except in very hot weather, coolers are not required.
5. Convenient working.
6. The lower large vats are available after vintage for wine storage.

Whether or not this system would prove an acquisition in our wineries can only be proved by experience. Algerian musts differ a good deal from ours. The Baumé gravity being usually between 10 and 12 deg., there is more juice in proportion to marc than with our denser musts.

For dry wine-making they should be well worth trying.

Sulphiting.

Sulphiting is now a household word in our wineries. It has achieved the same popularity that it did in the early years of this century in France.

Its evolution is interesting. Several authorities advised the more extensive use during fermentation of sulphur dioxide, a substance which had, from time immemorial, been used for the sterilization of casks, and occasionally also in wine-making—Gastine and Gladysz in 1895; Roos in 1898, and Martinand in 1900 deserve mention, but it was Dupont and Ventre who converted its occasional use into a regular wine-making method. The standard dose is still that advocated by these authorities over twenty years ago, viz., 10 to 15 centigrammes of SO_2 per litre.*

I was so struck by their articles in the *Progres Agricole* in 1906-7-8 that I published a review of the new development in the Victorian *Journal* of the Agricultural Department in January, 1911. I am, indeed, gratified to think that I have thus had "a finger in the pie" in popularizing this important practice in Australia.

It is true that prior to this, SO_2 was used in a somewhat similar way in some Australian cellars, but it is only during the past eighteen years that the method has become general.

Bisulphite or Sulphur Dioxide?

Excellent though the results have been, I do not think we apply our SO_2 in the best possible form. We very generally use what is commercially known as potassium meta-bisulphite.

This is a convenient salt of fairly constant composition and stability, answering to the formula $K_2S_2O_5$. Theoretically it should contain 57.66 per cent. of SO_2. It is sometimes sold subject to a guarantee of 55 per cent. In practice it may be looked upon as containing half its weight of SO_2. The other half consists of potash. This neutralizes a corresponding weight of tartaric acid of the wine, to form cream of tartar which is precipitated as argol. Thus the acidity of the wine is slightly reduced. Ventre considers this reduction to be fully compensated by the protection from destruction by wild yeasts &c., of several of the grape acids, but in view of the usually low acidity of Australian grapes, any reduction of acidity is undesirable. It would seem simple to add a little tartaric acid, together with the bisulphite, so as to precipitate its potash; the proper proportion would be 79 per cent. of the weight of bisulphite added.

In any case bisulphite is blamed in Europe with communicating to the wine a special flavour—a sort of slight bitterness. For this reason French pure wine law does not permit the addition to the must, or crushed grapes, of more than 20 grammes per hectolitre of potassium bisulphite, whilst it imposes no limit to the quantity of pure SO_2; excessive use is prevented by the limit allowed by French law in the finished wine, of 45 centigrammes per litre of total SO_2, of which not more than 18 centigrammes may be in the free state; a limit, incidentally, that is far more liberal than that allowed by Victorian law. It is the same as that fixed in Great Britain.

Now, 20 grammes per hectolitre is only 3.2 oz. per hundred gallons—enough for ordinary sulphiting, but a quantity that is often exceeded in our wineries, as it also is in France, and especially in Algeria. Hence the use, on a large scale, of other forms of SO_2.

* This is equivalent to 2½ to 4½ ozs. of Potassium metabisulphate per 100 gallons.

One of the most popular, and certainly the most logical, is liquid sulphur dioxide. The gas liquefies readily under pressure, and in this form it is conveniently handled in steel cylinders or even in glass vessels, something like a soda water syphon. From these it can be run directly into the must or crushed grapes, which it enters in the gaseous form and is readily absorbed. The correct dose can be determined by placing the cylinder on scales, the reduction in weight showing how much has been used.

Convenient appliances known as "sulfidoseurs" can also be fitted to the cylinders.

The tube conveying the gas to the vat should be moved from place to place to equalize distribution, and the contents of the vat rummaged. An even better way is to cause the gas to bubble into a cask of water so as to prepare a strong solution—what is known to the trade as S-ous. A solution can thus be prepared containing 6 per cent. of SO_2, which keeps well for three or four days. If kept longer it deteriorates.

The exact SO_2 content should be determined before use. This is easily done by a simple volumetric test with standard iodine, which any cellarman could carry out.

In Australia there is no legal restriction to the use of bisulphite save the SO_2 limit in the resulting wine. Nevertheless, I am of opinion that the substitution of liquefied sulphur dioxide for much of the bisulphite we now use would be an improvement. Potash is an expensive base; since it plays no useful purpose its addition is not economical. If a sufficient demand existed for liquefied SO_2 it could be made available more cheaply than in the bisulphite form; we would also escape the slight bitterness sometimes caused by heavy doses of this salt.

SO_2 can also be used in the gaseous form resulting form the combustion of sulphur. This entails the use of sulphurers or *muteuses,* several of which are described by Roos in *Wine Making in Hot Climates.* Part of the must can be heavily treated in this way, and used to sulphite the whole vat, a SO_2 determination indicating the proportion to be used.

In France, so-called nutritive SO_2 solutions are on the market, containing ammonium phosphate, which increases the capacity to hold the SO_2 and also its stability. The combining of the two substances has been picturesquely compared to whipping up a horse and at the same time putting on the brake; nevertheless, such proprietary brands as sulpho-phosphate, bio-sulphite, and others have long been largely used with satisfactory results. It seems logical, however, to use the constituents separately; SO_2 is most necessary at the commencement and ammonium phosphate towards the close of fermentation.

The Sulphide Taste.

This occasional accident is due to the reducing action of the yeast, in anaerobic life, on SO_2, with the result that traces of H_2S are produced, giving the wine an objectionable taste, recalling rotten eggs. It is avoided by occasional aeration, especially during the early stages of fermentation.

The mechanical pumps used in many wineries for must circulation prevent its development. In the absence of these, it can be prevented by aeration with a copper tube perforated at its lower end with small holes, through which air is forced with a tire inflator or other air pump. Five minutes' aeration twice a day for the first four days of fermentation effectually prevents it. Should it occur, its removal is usually effected by the aeration accompanying racking. It is also possible by the addition of a centigramme of SO_2 per litre ($\frac{3}{4}$ grain per gallon) if the taste be slight. This reacts on the H_2S to form water, and sulphur is precipitated. Early treatment is essential, otherwise more stable sulphur compounds may be formed, such as ethyle sulphide or mercaptan, to which is due the taste of garlic which sometimes develops. These more stable compounds can best be removed by contact with metallic copper. Passing the wine through a funnel filled with bright copper turnings removes the objectionable taste. The black coating of copper sulphide can be dissolved with dilute nitric acid and the turnings used repeatedly.

Refrigeration.

Indirect cooling with SO_2 has largely replaced direct cooling by means of attemperators, and yet the latter presents advantages that more than compensate for its inconvenience. Late additions of SO_2 are unsuitable for dry wines, as they interfere with the last stages of fermentation, making it difficult for high gravity musts to ferment out dry. For sweet wine it is of less consequence; besides, an adequate supply of really cold water is not always available. In my opinion, the time is coming when a well equipped winery will have its refrigerating plant. Cold storage would be an inestimable advantage during the first few months of the young wine's life. It would permit the early elimination of surplus tartar and insoluble impurities by sedimentation at aseptic temperatures. The maturing influence of oxygen would also be more marked, since the solubility of a gas increases as the temperature falls.

If cool storage is financially possible for beer it should likewise be so for wine.

Tannin.

The use of tannin in wine making is allowed by law in all countries. The addition of 6 or 7 centigrammes per litre (in round numbers an ounce to 100 gallons) to the must of white grapes as soon as possible after pressing has a very beneficial influence on the condition of the resulting wine. It brings about the elimination of albuminous, mucilaginous, and other nitrogen containing substances, which are the principal causes of subsequent condition trouble. Indeed, the above dose can usually be increased and even doubled in some cases with advantage.

It was in champagne that the benefits of this addition first became evident. This wine is largely made from red grapes. If colour extraction was to be avoided, pressing had to be so slight as to extract insufficient tannin; hence faulty wines, of viscous or ropy nature. Chemists traced the cause of the trouble, since when, the logical use of tannin has been a feature of champagne making.

The rapid and often insufficient pressing our white grapes now receive is very different from what obtained 50 years ago, when the cake of marc on the press was stirred, cut and re-cut several times, the last juice extracted being mixed with the first run, giving it tannin in adequate proportion.

Discussion of the tannin question means treading on dangerous ground. Professor Cohen, in his text-book on organic chemistry published only last year, states "The tannins vary much in character and little is known of their structure." The part played by the allied gallic acid, when tannin is added to wine, is somewhat obscure and probably important. Gallic acid is one of the impurities of commercial tannin. It does not precipitate gelatine, and would thus remain in the wine after fining.

It is essential that the tannin be of good quality and of a type suitable for cellar use. In France three types of tannin are sold by the trade, known respectively as water tannin, ether tannin, and alcohol tannin, according to the solvent used for their extraction. Water tannin is the most impure. Ether tannin is purer, but it retains a strong taste of ether, which is communicated to the wine. Alcohol tannin is the only form favoured by authorities.

Oenotannin, extracted from grape pips, is in general use and well suited for the purpose, as might logically be expected, but its price is high.

Avoidance of Metallic Contamination.

In my opinion wine comes too often in contact with metals in our wineries, and more particularly in small vineyard cellars. It certainly does so to a far greater extent than in former times, when wooden vessels only were tolerated. Hence frequent troubles from blue or ferric casse. The protective paraffin coating applied by careful managers easily scales off, leaving the metal exposed. Shellac is a more durable protector. Dissolved in spirit, it constitutes the "hard spirit varnish" obtainable from oil and colour stores. As Mathieu puts it, "every cellar where iron machinery is in use should have its pot of shellac varnish, as indispensable as a shifting spanner." Iron is the chief culprit. It is, no doubt, harmless to health, but very injurious to the condition of the wine.

Zinc and lead, however, are positively poisonous, and are easily attacked by wine acids. Galvanized iron should be absolutely banished from the winery, and yet, in small cellars, we sometimes see a galvanized tub used for racking wine.

Bronze or gunmetal and block tin are safe, but brass is unsuitable. Copper is not attacked provided it is clean and bright. Tin plate is admissible when new, but the tin coating soon perforates.

Kerosene tins, except when new and bright, are bad cellar utensils unless varnished.

In conclusion, there are several other points space compels me to cut out, such for example as the correction of deficient acidity, which merits more attention than it receives. Of the several points I have touched on I would more particularly draw your attention to the use of liquid sulphur di-oxide in place of bisulphite, the more extensive use of tannin, and the super-seven method of wine making.

THE ECONOMIC USE OF IRRIGATION WATER.

By L. C. Bartels, B.Ag.Sc., Senior Irrigation Officer.

Many considerations enter into the question of how to use irrigation water to best advantage.

If skilful methods of irrigation and cultivation are followed, waste will be reduced and maximum yields may be obtained with the water available. But the highest yields which may be economically obtained when water is properly used are governed by the value of the land, the cost of applying the water, the nature of the crop to be grown and the facilities available in labour and capital.

There are many phases of irrigated agriculture, but I propose to deal only with the general conditions in our irrigation districts and with reference mainly to lucerne, pastures, and the fodder crops commonly grown.

The object of every irrigation farmer should be to reduce waste of water-loss through run-off, deep soakage and evaporation.

Irrigation Practices.

Irrigation practices should be so ordered that water is under control; thus the importance of careful grading is apparent; but more than anything else, the care and judgment used by the farmer in applying water govern its economical use.

It is true that conditions vary and the refined practices used in market gardening or fruit-growing are not called for in irrigating wheat and oats, or natural grassland. With these, wild flooding is usual in some of the older irrigation districts of the State. Sometimes the water is merely turned into swamp areas; big areas of natural grass are watered; large banks are put up with plough and delver, and the water is stopped by these and spreads over the land. With this method, the distribution is irregular; water will lie in the depressions, but will miss the bumps and the resultant growth is irregular.

Sometimes the banks are brought closer together, and sometimes they are erected so as to enclose rectangular areas which are filled with water. These are the methods common on the Tragowel plains, and one may find in this fact an explanation of why the main crops grown there are millet and sorghums, and why lucerne growing has not been generally adopted.

So general is this style of irrigation that one assumes that more improved methods of water distribution are inapplicable till on investigation, one realizes that they have not been seriously tried. Evidence is becoming available to show that better methods may supersede the old methods with advantage, and hand in hand with better watering practice, better cropping methods and better crops will come.

Lucerne may be extensively grown and mixed pastures of grasses and clovers will follow. Farmers must graduate, as it were, in irrigation practices, and it is a fact that men in districts where water has but recently been made available, and who are inclined to apologize

for lack of experience, have not the handicap of older farmers confirmed in old methods, and the lay-out of their farms proves that they are receptive of new ideas.

One of the first steps in advance of these crude methods would be to aim at some soil surface preparation by filling depressions and erasing the bumps. Some of the northern plains lands have such flat grades that water spreads relatively easily, but the irregular growth presented after an irrigation shows that the watering has been very irregular, and one may lay it down as a first requirement in economical watering that if uniform growth is to be induced, the water should be put on as evenly as possible. Unless this desired end is secured, the high spots may not be wet at all and in the depressions there will be excess water. It may require more than one levelling and repeated work for more than a year to effect permanent improvement in the ground surface.

Carelessness in the use of water has in some cases led to permanent injury to the soil. Unfortunately, many an area which was productive before being spoilt by injudicious waterings now presents the appearance of a rush bed, or has been made barren by the rise of salt.

Another undesirable condition arises by allowing heavy stock to graze land during irrigation or too soon after watering, thus "pugging" the soil.

Excessive Watering to be Guarded Against.

It is safe to say that greater damage is likely through excessive watering than as a result of not using enough. Particularly is this so when waste may be averted by preparation of the ground, or by the exercise of care in applying the water. Any system of watering which a farmer claims to be economical must be considered in relation to its ultimate effect. Our Mallee soils will absorb water readily; there is not much danger of the water lying even if the ground is irregular; it soaks away; but there is danger of raising the water table and inducing salt.

Cross banks may facilitate the spread of water, but almost invariably they cause lucerne to become patchy, and grasses and clovers will suffer also if the water is banked on them when the weather is too hot.

What is called the border method of layout for irrigation is the one best suited for general conditions in Victoria, and is the one most widely adopted.

This system involves the division of the land into long narrow bays, bordered by check-banks. There are no cross-checks, and the distribution of the water is effected by levelling the bays from side to side. The banks run in the direction of greatest slope and a grade of from 1 to 3 inches per chain is very favorable. Sometimes, if the slope is excessive, the banks may run diagonally across the direction of fall, and an intermediate fall is thus secured. The resultant side fall is eliminated by grading.

It is plain to see that if the land slopes in two directions, more or less sidefall in the bays has to be corrected. When the bay is levelled across, the water spreads uniformly. The earth to be re-

moved in levelling is lessened when the banks are brought closer together. Ordinarily, if the banks are at 45 feet intervals, good work is done, but where sidefall is pronounced, the banks may be distanced two or even three to the chain.

The length of bays for most economical work ranges from 5 to 15 chains according to conditions; 10 chains is a convenient length. If the ground is porous, the run should be shortened. There is a likelihood of water being lost if it is running for too long on a porous soil, but the fall of the land has an important consideration, and if the grade is flat, short bays are advisable whether the land is porous or not.

If slopes are excessive, and scouring results from the flow of the water, terracing may be advisable, or the water may be distributed in furrows.

The irrigation farmer may ask—How much water does lucerne require for most economical production? Based on the Werribee experiments, 2 feet of water in six waterings in the irrigation season is given as the best quantity to apply.

Higher yields were obtained with more water, even up to 4 feet per annum, and the extra produce more than offset the extra cost of the water. But the results from the application of 4 feet of water were not satisfactory; the hay produced was rank, the lucerne thinned, and the results were not maintained beyond a couple of years.

It is not economical to use 36 inches of water on an area of lucerne, if by applying only 18 inches, the area may be doubled.

The Best Quantity to Apply.

Somewhere about 18 inches in a normal season is a desirable minimum to apply, and the reason is this—if 12 inches of water is distributed over the growing season in six waterings, each application is only 2 inches, and 2 inches of water does not penetrate the soil and the root growth is restricted, for too big a proportion of a 2 inch watering is lost by evaporation.

If a 3-inch watering is given, conditions are improved, and more than double the yield has been obtained at Werribee during the last three seasons when six 3-inch waterings were given as compared with six 2-inch waterings.

Herein is an important lesson for the irrigation farmer on clay loam soils. He knows that his lucerne growth is scanty and blames the soil as being unproductive. Greater attention to watering will improve matters considerably. The farmer may say "I water in the approved fashion and as often as my neighbour, how can I improve matters if my land will not take water."

A farmer who waters regularly and has his land well graded so that slow and careful watering is possible will be in the best position on the heavier soils, but even then the absorption may be only 2 inches at a watering and growth is restricted accordingly.

The soils in the Goulburn Valley in many places present such difficulties. Tests have been conducted with dressings of gypsum and lime, as well as with sub-soiling in the hope of finding a means of making the soils more permeable to water.

By far the most effective means tried has been supplementary watering, i.e., giving a second or even a third watering a day or two after the first; only a small stream is needed; it will spread more easily in the second watering.

As I have stated before, if the 2-inch watering is made a 3-inch watering or the 3 inch a 4 inch, the water cost of the lucerne is lowered.

Care must be taken not to use this method where drainage is bad and there is a danger of drowning the lucerne. The difficulties on badly graded land may be aggravated if extra water is given.

The use of the water meters is to be commended, and irrigation farmers should take an interest in the duty of water, that is the relation between the quantity of water used and the area it serves. An intelligent understanding of this will make for the economical use of water, and from my observations, I can assure irrigationists that in most cases, the meter will favour them as compared with the old method of paying a flat rate for a watering.

The Dethridge meter is in common use; the water wheels are familiar to all in irrigation districts. The small cyclometer which registers the revolutions is fixed on the axle and shows acre feet, tenths and hundredths of acre feet, and the recordings may be easily read.

If water is coming in at the rate of a cubic foot per second, it will be found that the total delivery in a day is 2 acre feet. For an acre foot, the wheel should turn 1,500 times; for every fifteen turns the cyclometer moves one figure indicating one 1-100th acre foot.

An acre foot means the quantity of water which would cover an acre a foot deep—and 3 acres 4 inches.

The number of turns of the wheel per minute very nearly equals the number of acre feet delivered per day.

Not many farmers are able to say how much water their land will take, and many are inclined to blame the soil as unproductive when more attention to irrigation would improve growth.

Should Lucerne be Grown where Irrigation is Uncertain?

A point often raised by irrigation farmers outside the Closer Settlement areas is this:—Since we are not assured of a regular and frequent water supply, it would not be wise for us to sow down permanent crops like lucerne and pastures. As a matter of fact, there is no crop better adapted than lucerne for such circumstances. While lucerne yields best when watered regularly and in adequate amounts to promote continuous growth, it has great resistance to dryness and it is safe to predict that if farmers give it a fair trial, i.e., take care in establishing and maintaining it by top-dressing and by judicious grazing, much greater areas would be sown. It is becoming more and more evident from the experience of a few farmers on the Tragowel plains, that there are great opportunities for the extension of lucerne growing. It is essentially a summer fodder, but it makes good growth in winter too, if it is top-dressed.

What of mixed pastures under these circumstances? They have done well under intensive farming systems, but for best results, regular watering is an essential. There are, however, some grasses and clovers which have a greater power of withstanding dryness than others, and

by taking advantage of the fact that some are winter growers, a selection may be made. Foremost stand Subterranean clover and Wimmera rye grass, both of which are winter growers, and although annuals, will reseed, and come up in successive years if given a reasonable chance. If a watering is given in autumn to start these fodders, and again in spring, they will be very productive. There are possibilities in the same direction with Toowoomba canary grass, tall oat grass, and sheep's Burnett, and whatever their limitations, their cultivation is a much better business than the watering of native grasses or filling swamps by irrigation. Though even swamps may be made more productive, if paspalum and strawberry clover are introduced.

One other factor which makes for profitable results from irrigated crops is manuring, and it is pleasing to note that the use of super is extending every year.

AGRICULTURAL RESEARCH IN THE UNITED KINGDOM.

The future material development of mankind appears to be so closely linked with increased knowledge gained by scientific research that National Parliaments the world over are spending increasingly large sums in its encouragement. This is altogether proper.

Thus to-day in all parts of the world investigations of amazing diversity are being prosecuted.

The results of active investigation, however, brings other problems to light, among which perhaps the chief is that of disseminating and ensuring the application of information so obtained.

The man on the land himself obviously cannot keep in touch directly with progress in scientific investigations in the wide field he is interested in. Indeed it is difficult for those charged with the duty of giving scientific advice to keep themselves in close and intimate touch with advances in knowledge made in many parts of the world. For these reasons we welcome the receipt of a publication entitled *Abstracts of Papers on Agricultural Research in the United Kingdom*, published during the year October, 1927, to September, 1928, issued in 1929 by the Ministry of Agriculture and Fisheries, London (Price 1s.). The excellent abstracts range from such subjects as soils and plant nutrition through entomology and dairying to agricultural engineering and economics; and portray in concise, condensed form progress made in these subjects.

The abstracts themselves have been prepared in such a way that they indicate practical applications which may flow from the investigations.

This booklet will serve to keep leaders in agricultural thought up to date on recent scientific developments in all branches of agriculture. It will give useful working information to the many scientific agricultural advisers throughout the Empire, and the specialist will find it useful as a guide to information on special problems. All these people, and through them a wider public, are indebted to the Empire Marketing Board for fostering this plan of drawing together and publishing year by year this fine record of British achievement in the field of scientific agricultural research. D.B.A.

CHAMPAGNE.*

By F. de Castella, Viticulturist.

If Champagne is not the king of wines, it certainly is their "Beau Brummel," for it is an exquisite among the elegants of the wine world, the spoilt favourite of courts and millionaires.

France produces many excellent wines, but the three most celebrated are undoubtedly Bordeaux (better known in England as clarets), Burgundy, and Champagne. The last is a name to conjure by the world over. Without it, no ceremonial dinner is complete. At birthday parties and family gatherings its very presence indicates that the occasion is a special one. The pop of the cork, and the foam and froth as the wine is poured out, confirm this impression, and the little bubbles that for quite a while arise from the depths and chase one another to the surface, where they burst, have a charm all of their own—making it something peculiarly attractive, something living. Then the pleasing effect on the guests! It enlivens without intoxicating, and causes what without it would be a dull assemblage to sparkle and become brilliant. Hence, the appropriateness of the English term "sparkling wines" applied to all this group, as distinguished from still wines. This quite noticeable but gentle exhilaration is, indeed, curious, for the alcohol strength is not high, very little more than Claret, and not so much as Burgundy. It is well known to all, and even utilized by the medical profession. Are not invalids and convalescents sometimes restored with this remarkable wine?

Of sparkling wines, Champagne is easily the first; so much so that this name is often misapplied in a generic or type sense to designate a sparkling wine grown elsewhere than in Champagne. It is essentially a regional name.

Champagne is the produce solely of the ancient French province of that name. The term has, indeed, been further restricted by French law to the area delimited as the Champagne district. Sparkling wines are made in other parts of France, notably Saumur and Sparkling Burgundy. These are excellent wines, and are made and handled in exactly similar manner, but they are not Champagne. The privileged region that yields this unique wine presents several interesting features. It is at the northern limit of the climatic zone in which the vine can be successfully cultivated. Farther north, there are no vineyards. So cold is it that the vines are completely buried each season to protect them from the intense winter cold. Another peculiarity is the very close planting, the distance apart being barely 18 inches; no less than 20,000 vines are planted to the acre. So close are they that tillage must be executed by hand labour. This very close planting is a consequence of the cold climate, for it is a very general rule that the closer the vines are planted the better do the grapes ripen and the more sugar do they contain. With wider planting a wine of such exceptional quality could not be made in that climate.

Champagne differs from most other choice wines in that it is made from one vine sort only: the Pinot. Of this there are several subvarieties, the chief being the black, the pink, and the white; each

* Broadcast through 3LO.

predominates in a different part of the district. The black variety, which we know in Victoria under the name of "Miller's Burgundy," from the white tomentum present on the leaves, is the most important. Champagne is thus an example of a white wine largely made from black grapes.

The soil is chalk. Some of the best vineyard soils contain so much lime that it was difficult to find suitable resistant stocks when phylloxera forced the replanting of the vineyards. Though typical of the district, and having a bearing on the special character of its wine, abundant lime is not essential to quality. The excellent wines of Saumur and the sparkling hocks of the Rhine are grown on soil poor in lime.

This chalk formation lends itself to the construction of the remarkable cellars for which the district is famous. Tunnels cut in the soft rock many feet beneath the surface, where the temperature is low and constant and where there is no vibration from traffic—conditions essential to the making of the wine.

Keats must have had Champagne in mind when he wrote, "Oh, for a draught of vintage! that hath been cooled a long age in the deep delved earth." "The beaded bubbles winking at the brim" also suggest it—though the "purple stained mouth" is more in keeping with sparkling Burgundy. This last is made in the neighbouring district, celebrated since time immemorial for its dry red wines. The sparkling variety, though a wine of high quality, is scarcely in the same class as Champagne. It is rather a newcomer in comparison, the type having been evolved not so many years back to suit the English customer. Champagne, on the contrary, is a veteran. Since its chance discovery, over 200 years ago, it soon forced itself to the very front among wines, and has retained this pre-eminence ever since. It is, of course, expensive; this is its chief defect, but when one considers how it is made, it is impossible that it should be otherwise.

The process was invented in the 17th century by Dom Perignon, the lay brother in charge of the cellars at the Benedictine Monastery of Hautvilliers, between Ay and Epernay. It was a chance discovery. Some wine, bottled before the complete fermentation of all its sugar, proved to be sparkling when it was uncorked. By adding a little pure sugar to a dry wine immediately before bottling, he was able to repeat the second fermentation in the bottle itself, which is the secret of the making of sparkling wines.

A distinction must be drawn between natural sparkling wines, made in this way, and artificial or carbonated wines, in which the carbon-dioxide is merely forced into the wine under pressure; they are, in fact, equivalent to sodawater made with wine instead of water, and are but a poor imitation of the real thing.

Natural sparkling wine contains the same carbon-dioxide, but as the result of fermentation within the bottle. The resulting wine and its effect on the palate are vastly different.

Modern champagne-making differs really but little from Dom Perignon's method, though it has been brought up to date, and is now subject to scientific control.

A dry light wine is first made by the usual methods, much in the same way as a Chablis or Hock. When sufficiently advanced, which is usually at about two years from vintage, it enters on the special

treatment that is to transform it from a still wine into a sparkling wine. This consists essentially in a second fermentation in bottle to engender the necessary carbon-dioxide gas. To render this fermentation possible, small quantities of pure sugar and yeast are added. The proportion of the first must be nicely calculated, so that the resulting pressure will be sufficient but not excessive. These additions are made to the wine in bulk, and it is immediately bottled in the very bottles in which it will reach the consumer. These are tightly corked and clamped with what is known as the *agrafe;* bottling and fermentation take place in the above-ground cellars. Fermentation soon starts. After its completion, a matter of a couple of weeks, the wine is sparkling, certainly, but by no means in fit condition for market. In addition to producing alcohol and carbon-dioxide, the fermentation has developed a new crop of yeast cells, constituting a sediment or deposit which must be eliminated before the wine can be clear and limpid. Its removal is accomplished by an ingenious trick known as *disgorging.* After the completion of fermentation, the wine is transferred to the underground cellars, where it remains for three or four years before being disgorged. The sediment is brought to the right consistency by occasional shaking of the bottles, after each of which they are restacked. This treatment is repeated six times, the first and usually less often during the subsequent years. The bottles are then transferred to the shaking tables or frames, in which they are placed, cork downwards, and dexterously shaken—or rather rotated rapidly—once a day during a period of several weeks. In this way the whole of the sediment is gradually concentrated in a narrow zone just above the cork.

Disgorging consists in releasing the agrafe of the still inverted bottle. The cork is blown out, together with the sediment, by the gas pressure. The operator dexterously prevents the escape of more than about an ounce of wine by blocking the neck with his hand. The bottle is next placed upright in an appliance, where the further escape of gas is prevented; the slight ullage is replenished with some of the same wine, and it is *liqueured* with a very little sweet wine. It is next corked with the *Expedition* cork by a special machine and passed on to the *Mouselet* machine, which wires it and attaches the *plaque.* After a rest of some months, or even years, it is ready for sale. Labels and gold foil are only affixed prior to sale.

Before disgorging, the internal pressure is a good deal higher than is necessary in the finished wine. This is rectified by the gas lost during the different manipulations. These must be rapidly performed, so that the final pressure is just what is required, viz., about 60 lb. to the square inch (4 atmospheres).

When one considers the constant attention and handling that each bottle of Champagne needs, extending over several years, it is not surprising that it is not a cheap wine. Indeed, the wonder is that it can be turned out at the price. It has truly been said that the making of Champagne commences when that of most other wines is finished.

In conclusion, I would strongly advocate better appreciation of the excellent sparkling wines Australia now produces. Some critics say they are not Champagne. They certainly do not profess to be. They

are, nevertheless, admirable wines of the same class, made and handled in exactly similar manner.

A curious thing about wine is that no one sort is ever the same as another. A Burgundy is not a Claret. Natives of either district prefer the wine of their own district. Both are excellent, and neither is, or tries to be, a copy of the other. So it is with our Australian sparkling wines, which have now reached a most gratifying standard of excellence.

BUTTER SITUATION IN CANADA.

The butter situation in 1928 resulted in a wrong view being taken of the Canadian dairy industry. Canadian butter imports in that year jumped from 11,208,819 lb. (worth $3,892,640) to 16,801,656 lb. (worth $5,937,170). Thus Canada's unfavorable balance as regards butter rose in the twelve months from 8,512,819 lb. to 14,806,856 lb. This compares with a favorable balance of over 12,000,000 lb. in 1924, and of over 24,000,000 lb. in 1925. The main source of import was New Zealand, from which country purchases increased from 8,714,985 lb. (worth $3,023,801) in 1927, to 16,124,641 lb. (worth $5,673,388) in 1928. Imports in the same period doubled from Australia, while those from the United Kingdom and the United States declined drastically.

The fact is that, due to the demand for cream in other forms of dairy products, the butter industry in Canada has been temporarily neglected in an inability to keep up with the demand. The situation is scarcely one to be deplored but should rather be a source of gratification as evidencing the demand for Canada's dairy products, and throwing into the clearest relief the opportunity existing in the dairy industry in the Dominion to-day. In addition to a growing home demand to meet, the Dominion has established outside markets for a wide variety of dairy products which it cannot at present satisfy. There is unquestionably a period of expansion ahead for the dairy industry in Canada.

Indications that this is taking place are to be found in all parts of the country, in spite of a severe drain upon the Dominion's dairy herds as the result of heavy demand from the United States. The Province of Saskatchewan, which had such a remarkable rise as a butter producer and temporarily waned, has in 1929 been recording substantial monthly increases in production over 1928, and expects to create a new record by the end of the year. The progress which is being made in the Maritimes is noteworthy and significant in view of the development of trade with the British West Indies. New Brunswick, in 1928, made 161,492 lb. of butter more than in the previous year; and Prince Edward Island maintains its reputation for high standard, provincial dairymen securing the highest score for quality in Canada. A section which is staging a remarkable dairy development is the Okanagan Valley of British Columbia, where, it is claimed, butter can be produced very economically. In 1928, the Okanagan Valley Co-operative Creamery made and distributed 519,398 lb. of butter, a signal achievement for a region regarded solely as a fruit-producing one.—(*Agricultural and Industrial Progress in Canada.*")

NOTES ON PLANT DISEASES.

RHIZOCTONIA DISEASE IN POTATOES.

By D. B. Adam, Vegetable Pathologist.

On the surface of very many potato tubers one may see small, dark-brown, irregular-shaped particles of a substance that looks much like soil. On washing these potatoes, however, the particles assume a darker, almost black, colour. Furthermore, while they can be scraped off easily enough with the finger nail, they do not wash off readily, as they would were they soil only. These innocent-looking little bodies are, in fact, part of the substance of the fungus named *Rhizoctonia solani.*

They are, indeed, an important link in the life-history of the fungus, being as important as, and quite comparable with, the part the tuber plays in the life-history of the potato plant. These soil-like particles, scientifically known as sclerotia, provide one very important means whereby the fungus, and hence the disease which it causes, is perpetuated from year to year.

From the farmer's point of view, this aspect of the fungus life-cycle is important, since present methods for the control of Rhizoctonia disease caused by the fungus are based on the plan of rendering these sclerotia harmless by seed disinfection. Actually, the value of seed disinfection for the control of this disease has been recognized and practised for a long time in the United States and other countries.

In this country, although the disease has been recognized for a long time, no systematic attempt has been made, either to determine its economic importance under Victorian conditions or to test locally, under field experimental conditions, the various seed disinfection methods employed in other countries. To meet this position, the Department commenced this year a series of experimental plots on different farms in the Koroit district.

The plots have been arranged so that we can obtain information on the relative effect of dipping diseased potatoes in—

1. Cold formalin solution (1 lb. to 15 gallons) for 2 hours.
2. Hot formalin (122° F.) solution (1 lb. to 15 gallons) for 15 minutes.
3. Cold corrosive sublimate solution (1 lb. to 100 gallons) for 2 hours—

on (*a*) the yield of the resultant crop, and
(*b*) the percentage of disease present as measured by different standards.

The experiments are being conducted with early, mid-season, and late plantings, since it appears that the disease varies somewhat in its severity at different plantings. There also are other possibilities, such as the fact that a percentage of the infection in a crop may arise from fungus in the soil from a previous diseased crop; these have had to be taken into consideration in planning the plots.

The disease due to this fungus expresses itself in a wide variety of symptoms. For the present, symptoms associated with "misses" in the crop will be described. These "misses," often disregarded alto-

gether as symptoms of a disease, are, in fact, quite frequently the result of an early attack of the Rhizoctonia fungus.

The illustration below shows a tuber which was one of a set that had apparently "missed." Actually, what had happened, and it can be clearly seen in the photograph, is that the young shoots, when they had reached a certain stage in their development, became so completely parasitised by the fungus that they ceased to grow. Lower down on the same shoots a second sprout emerged, but frequently this shoot was so completely invaded by the fungus that it, too, ceased to grow. Further sprouting took place from the base of these secondary shoots, but these sprouts were weakly, and, although with increasingly warmer growing conditions they might have outgrown the fungus, the resultant plant would have been so weakened that it would

have been economically unprofitable. However, the capacity for the Rhizoctonia fungus to attack the young shoots may remain unabated. In one set, neighbour to that from which the tuber illustrated was taken, there was a tuber that had made five unsuccessful attempts to sprout; the growing tip each time had been destroyed by fungus attack.

Closer examination of the illustration at the point marked X will reveal the presence of small sclerotia similar in structure to the soil-like particles described as adhering to the tuber.

These small sclerotia may serve as a form for further infection later in the season of those shoots which, while damaged by fungus attack, are sufficiently vigorous to emerge from the ground and grow to a point.

A description of later symptoms of this disease will be held over for a future article.

SPRAYING COSTS IN CODLING MOTH CONTROL.

By R. T. M. Pescott, B.Agr.Sc., Science Field Officer.

During recent years, the use of arsenate of lead alone as a spray for the control of Codling Moth has not proved satisfactory. Departmental tests at Harcourt showed that a more satisfactory control was obtained when the following spray programme was followed:—Two calyx sprays of arsenate of lead (5 lb. in 80 gallons) at ten days' interval, followed by three applications of white oil emulsion (2½ per cent.) at intervals of three weeks.

Numerous inquiries have been made as to the practicability of this latter spray programme, mainly on the question of cost. It may therefore be well to set out in detail the costs of the spray materials that would be used in the old standard arsenate of lead programme, and compare them with the arsenate of lead and oil programme.

As a basis on which to work, it is necessary to know how far a given quantity of spray will go. It is quite impossible to say that one barrel of spray (80 gallons) will spray a definite number of trees, mainly because of so many varying factors, such as the size of the trees and the potential crop. It is more satisfactory to adjust the amount of spray to the estimated yield of the tree. In the following calculations it will be assumed that one barrel of spray (80 gallons) is the minimum quantity necessary to spray 100 cases of fruit in order to obtain satisfactory results.

Arsenate of Lead Programme.

The minimum number of arsenate of lead sprays required to obtain a fair result is probably six; whilst in many districts as many as eight or nine have been found necessary. The cost of arsenate of lead may be reckoned at 8d. per lb., so that for 80 gallons of spray, allowing 5 lb. of arsenate of lead in 80 gallons of water, the cost would be 3s. 4d. per barrel; thus, for six sprays, the estimated cost would be 20s.

Arsenate of Lead Followed by White Oil Emulsion.

The two calyx sprays in the programme are of arsenate of lead (5 lb. in 80 gallons), and would cost, on the previous price, 6s. 8d. per barrel. The price of the white oil emulsion can be quite safely estimated at 8s. per gallon, which is the present maximum market price. Three sprays of white oil at 1 in 40 would thus cost 48s. per barrel of 80 gallons. The total cost of the combined programme is, therefore, 54s. 8d., or £1 14s. 8d. more than the cost of spraying with arsenate of lead alone.

Spreader.

If spreaders are used, the cost of each spraying will be slightly increased; but, since there are six sprays in the former programme compared with five in the latter, the balance is in the favour of the oil combination. However, the difference in costs is so small that the use of a spreader need not enter into our consideration.

Control.

The average result of two years' experiment at Harcourt (1927-28-29) is as follows:—

1. Arsenate of lead, five or six sprays—36 per cent. of fruit infested with codling.
2. Arsenate of lead, two calyx sprays followed by three white white oil sprays—12 per cent. of fruit infested with codling.

The oil sprays thus show an advantage of 24 per cent. over the no oil spray.

Assuming, for the purposes of our argument, that the difference be only 10 per cent. in favour of the arsenate of lead and oil spray, this represents an increased yield of saleable fruit of ten cases for every 100 borne by the trees treated. If we allow only four shillings per case for the fruit, which is certainly a conservative estimate, the value of the crop is thus increased by £2 for each barrel of spray used, which more than meets the £1 14s. 8d., increased cost of spray.

As, however, there has usually been a greater difference than 10 per cent. between the two types of spraying, the estimated margin of profit, of course, would be greater.

Apart from these monetary considerations, there are two other important considerations:—

1. There are only five sprayings in the oil programme as compared with at least six in the no oil spray. This means a reduction in labour cost.
2. The oil sprays give complete control of Red Spider, San Jose Scale, and Apple Mussel Scale; this is not accomplished with arsenate of lead alone.

For both economic and biological reasons, the advantages are in favour of the oil spray, and it must be remembered that the additional expense is more than covered by the increase in production.

RESULTS OF POTATO MANURIAL TRIALS, 1928-29.

(Continued from page 606.)

By J. T. Ramsay, Potato Expert.

Catani.

The yields resulting from the manure trials at Catani last season were disappointing. During December, 1928, and January of this year, severe frosts so affected the crop that they never recovered to a normal condition of development. The yields consequently were very light. However, six seasons have passed now since the introduction of the standardization of the manurial variations at Catani, and taking last year's returns in conjunction with the previous five, the figures are interesting and informative.

The first table given shows the yields from the various manures for each of the six years. Considerable fluctuation will be noted—due entirely, of course, to seasonal influences.

The second table shows the average performance of each manurial treatment for the six-year period. Since the greater the number from which the average is taken, the truer the average is, it follows that these figures are becoming increasingly valuable.

A study of the second table will show that the Catani soil is one of those which responds best to fairly heavy dressings of fertilizers. For instance, there is a marked percentage increase in the weight of the crop between the super dressings of 3, 6, and 9 cwt. per acre. The combination, however, which shows to the best advantage over the six-year period is the dressing now widely known as 6 and 1—that is, 6 cwt. superphosphate and 1 cwt. ammonium sulphate per acre. It is true, of course, that the average for the complete manure—number seven dressing—containing 6 cwt. super., 1 cwt. ammon. sulphate, and 1 cwt. potassium sulphate per acre, is 2 per cent. higher than number six, but it has to be considered that this is obtained only at an increased expenditure of 15s. 6d. per acre, which nullifies the benefit derived when the matter is considered from the economic point of view.

The 6 and 1 mixture has been so consistent in its performance that it must be accepted as the best yet discovered for this class of country. It is certainly possible that some combination or variation in weight proportions of the 6 and 1 constituents may ultimately displace it from its leading position, but until a better dressing is proved, farmers would be well advised to apply the application which has best stood up to the collar in these manure trials.

The soil analysis for Catani and the rainfall for the six months, 29th October to 30th March, are given hereunder:—

CATANI SOIL ANALYSIS.

Nitrogen	627 parts per 100,000.
Phosphoric acid	176 „ „ „
Potash	193 „ „ „

RAINFALL AT CATANI FOR 6 MONTHS.

October, 1928	.. ..	664 points.
November, 1928	.. ..	233 „
December, 1928	.. ..	186 „
January, 1929	.. ..	238 „
February, 1929	.. ..	245 „
March, 1929	.. ..	244 „
Total	..	1,810 „

The rainfall, as will be seen, was adequate, but as previously mentioned, the frosts cut the crop to pieces last season. The following tables give the results from the manures, and are presented without further comment.

TABLE I.—RETURN OF MANURE TRIALS ON POTATOES FOR 6 YEARS.

(Conducted on the farm of Mr. E. Cleversley, Catani.—Soil: Swamp peat.)

—	1.	2.	3.	4.	5.	6.	7.	8.	9.
	T. c. q.	T. c. q.	T. c. q.	T. c. q.	T. c. q.	T. c. q.	T. c. q.	T. c. q.	T. c. q.
1923-24	7 7 0	7 10 0	8 2 2	8 2 2	4 0 0	9 7 2	10 12 0	4 10 0	6 0 0
1924-25	3 7 2	4 12 0	5 6 0	2 15 0	2 5 0	5 18 0	5 10 0	3 5 0	3 10 0
1925-26	7 15 0	8 10 0	10 12 2	9 0 0	5 0 0	11 10 0	11 10 0	8 15 0	11 15 0
1926-27	2 5 1	2 8 0	2 8 0	2 6 3	1 4 0	2 11 0	2 12 1	2 13 2	2 2 2
1927-28	3 7 2	3 10 0	3 12 2	3 12 2	1 7 2	4 5 0	3 15 0	3 7 2	2 15 0
1928-29	0 14 3	1 0 0	0 18 3	0 18 3	0 5 1	1 8 0	1 8 0	0 10 3	0 8 0

The various manures indicated in Table I. by figures 1 to 9 are set out in Table II. below, together with the average yield per acre, the average increase due to manure, and the percentage of the average increase.

TABLE II.—AVERAGE RETURNS AT CATANI FOR 6 YEARS, 1923–24 TO 1928–29.

(Swamp land, Gippsland.)

Plot.	Manure.	Average Yield per Acre.	Average Increase due to Manure.	Average Per Cent. Increase.
		T. c. q.	T. c. q.	%
1	3 cwt. super.	4 2 3	1 16 0	71
2	6 cwt. super.	4 11 2	2 4 3	95
3	9 cwt. super.	5 3 1	2 16 2	120
4	6 cwt. super., 1 cwt. pot. sulph. ..	4 9 1	2 2 2	90
5	No manure	2 6 3	..	..
6	6 cwt. super. and 1 ammon. sulph. ..	5 16 2	3 9 3	149
7	6 cwt. super., 1 cwt. pot. sulph., 1 cwt. ammon. sulph.	5 17 3	3 11 0	151
8	3 cwt. market garden	3 16 3	1 10 0	62
9	3 cwt. bas. phos.	4 8 1	2 1 2	87

Fish Creek.

Particularly good results were harvested from the Fish Creek plots last season. The dressing showing the best return at this place strangely enough is the 6 cwt. per acre of superphosphate by itself. However, as this is the first season in which these trials have been conducted, it

is not wise to accept the figures absolutely as final; corroboration over a series of years is necessary to eliminate possible erraticism of soil conditions. The general effect of manures on the Fish Creek gray clay loam is good. It will be seen that the increase in the case of all manures was constant and appreciable. The results for the current season should be interesting.

TABLE III.—RESULTS OF POTATO MANURE TRIALS AT FISH CREEK, 1928–29.

(Conducted on the farm of Mr. R. Skinner.—Soil: Gray clay loam.)

Plot.	Manure per Acre.	Market Size Tubers.	Increase due to Manures.	Cost of Manure.	Cost per Ton Increase.	Increased Value per Acre.	Net Increased Value.	Per-centage Increase.
		T. c. q.	T. c. q.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	%
1	3 cwt. super. ..	10 6 1	3 12 2	0 18 9	0 5 6	43 10 0	42 11 3	54
2	6 cwt. super. ..	11 7 2	4 13 3	1 17 6	0 8 0	56 5 0	54 7 6	70
3	9 cwt. super. ..	9 0 0	2 6 1	2 16 3	1 4 4	27 15 0	24 18 9	34
4	6 cwt. super., 1 cwt. pot. sulph. ..	10 3 2	3 9 3	2 13 0	0 15 2	41 17 0	39 4 0	52
5	Nil	6 13 3	..	..	..	..	..	..
6	6 cwt. super., 1 cwt. ammon. sulph. ..	10 17 3	4 4 0	2 14 3	0 12 11	50 8 0	47 13 9	62
7	6 cwt. super., 1 cwt. ammon. sulph., 1 cwt. pot. sulph...	10 3 2	3 9 3	3 9 9	1 0 0	41 17 0	38 7 3	52
8	3 cwt. market garden manure ..	9 0 0	2 6 1	1 8 6	0 12 4	27 15 0	26 6 6	34
9	3 cwt. basic phos. ..	7 12 2	0 18 3	0 19 6	1 1 1	10 5 0	9 5 6	14

Only two crops off previously, and had been under grass for 5 years.

Trentham East.

The indications from the Trentham figures are that only moderate applications of superphosphate are profitable on this red volcanic loam

There were two factors operating on this plot last season which considerably affected the yields. The first was a severe frost in February, 1929, and the second a rather severe early leaf blight affectation. These two, in combination, had a disastrous effect on the yield, and somewhat nullify the value of the returns, which are simply recorded as obtained.

TABLE IV.—RESULTS OF POTATO MANURE TRIALS, TRENTHAM EAST, 1928–29.

(On the farm of Mr. E. Brodie.—Red volcanic loam.)

Plot.	Manure per Acre.	Market Size Tubers.	Increase due to Manures.	Cost of Manure.	Cost per Ton Increase.	Increased Value per Acre.	Net Increased Value.	Per-centage Increase.
		T. c. q.	T. c. q.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	%
1	2 cwt. super. ..	1 9 1	1 4 1	0 12 6	0 10 6	14 11 0	13 18 6	82
2	3 cwt. super. ..	1 12 2	1 7 2	0 18 9	0 14 0	16 10 0	15 11 3	84
3	4 cwt. super. ..	1 7 2	1 2 2	1 5 0	1 2 8	13 10 0	12 10 0	81
4	3 cwt. super., 1 cwt. ammon. sulph. ..	1 10 2	1 5 2	1 15 6	1 8 5	15 6 0	13 10 6	88
5	None	0 5 0	..	..	..	..	..	..
6	6 cwt. super., 1 cwt. ammon. sulph. ..	1 1 3	0 16 3	2 14 3	3 4 8	10 1 0	7 6 9	77
7	6 cwt. super., 1 cwt. ammon. sulph., 1 cwt. pot. sulph ..	1 1 3	0 16 3	3 9 9	4 2 4	10 1 0	6 11 3	77
8	3 cwt. market garden	1 0 0	0 15 0	1 8 6	1 18 0	9 0 0	7 11 6	75
9	3 cwt. basic phos. ..	0 18 1	0 13 1	0 19 6	1 7 0	7 19 0	6 19 6	71

Koroit.

The Koroit returns were light, chiefly owing to the damage done by the fungus *Rhizoctonia solani* (collar stem rot). This disease was very prevalent in the district last season, and was so severe on the manure trial plots that only 22 plants per chain were harvested. Nevertheless, substantial percentage increases were shown in favour of the manures. These, however, will require corroboration from further tests before they can be accepted.

It will be noticed that smaller ratings of manure per acre are tested at Koroit, Illowa, and Trentham East than on the Gippsland stations. Smaller quantities are also being tested at Millbrook. The reason for this is that these volcanic soils are inherently richer and do not demand the same weight of fertilizer to produce their maximum yield.

TABLE V.—RESULTS OF MANURE TRIALS ON POTATOES AT KOROIT, 1928–29.

(Conducted on the farm of Mr. J. Wilkinson.—Soil: Dark volcanic.)

Plot.	Manure per Acre.	Market Size Tubers.	Increase due to Manures.	Cost of Manure.	Cost per Ton Increase.	Increased Value per Acre.	Net Increased Value.	Percentage Increase.
		T. c. q.	T. c. q.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	%
1	2 cwt. super. ..	2 17 0	0 16 0	0 12 6	0 15 0	9 18 0	9 5 6	39
2	3 cwt. super. ..	2 17 2	0 16 0	0 18 9	1 3 6	9 12 0	8 13 3	38
3	4 cwt. super. ..	3 8 2	1 7 0	1 5 0	0 18 6	16 4 0	14 19 0	65
4	3 cwt. super., 1 cwt. super. ammon. ..	3 8 2	1 7 0	1 15 6	1 6 0	16 4 0	14 8 6	65
5	No manure ..	2 1 2	..	..	..	..	..	..
6	6 cwt. super., 1 cwt. ammon. sulph. ..	3 3 0	1 1 2	2 14 3	2 11 0	12 18 0	10 3 9	50
7	6 cwt. super., 1 cwt. pot. sulph., 1 cwt. ammon. sulph. ..	2 17 0	0 16 2	3 9 9	4 6 3	9 18 0	6 8 3	39
8	3 cwt. market garden	2 17 0	0 16 2	1 8 6	3 9 0	9 18 0	8 9 6	39
9	3 cwt. basic phos. ..	2 17 0	0 16 2	0 19 6	1 2 1	9 18 0	8 18 6	39

Illowa.

Satisfactory results attended the trials on the red volcanic soil at Illowa. Here again we have strong indications that moderate dressings of super. are likely to prove most beneficial. The highest percentage increase, viz., 68 per cent., was obtained from number 2 application, 3 cwt. super. per acre.

It is remarkable that the addition of ammonium sulphate and heavier applications of super. actually depressed the yields.

The lighter crop due to ammonium sulphate is perhaps understandable when the analysis of this soil is studied.

ILLOWA SOIL ANALYSIS.

Nitrogen	392	parts per 100,000
Phosphoric acid	275	„ „ „
Potash	362	„ „ „

Thus it will be seen that this soil contains nitrogen far in excess of the plant's requirements.

It is not so easily understood, however, why the increase over 3 cwt. per acre of super. reduces the yield, yet such undoubtedly is the case.

The results given in Table VI. are informative and dispel the idea that these rich lands of the Western District will not respond to judicious manuring.

TABLE VI.—RESULTS OF POTATO MANURE TRIALS AT ILLOWA, 1928-29.
(Conducted on the farm of Messrs. Sheen Bros.—Soil: Red volcanic.)

Plot	Manure per Acre.	Market Size Tubers.	Increase due to Manures.	Cost of Manure.	Cost per Ton Increase.	Increased Value per Acre.	Net Increased Value.	Percentage Increase.
		T. c. q.	T. c. q.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	%
1	2 cwt. super. ..	5 3 3	1 14 3	0 12 6	0 7 0	20 17 0	20 4 6	50
2	3 cwt. super. ..	5 12 0	2 3 0	0 18 9	0 8 9	25 16 0	24 17 3	68
3	4 cwt. super. ..	5 6 2	1 17 2	1 5 0	0 13 4	22 10 0	21 5 0	54
4	3 cwt. super., 1 cwt. ammon. sulph. ..	4 15 2	1 6 2	1 15 6	1 6 6	15 18 0	13 2 6	38
5	No manure ..	3 9 0	..	..	..	..	..	..
6	6 cwt. super., 1 cwt. sulph. ammon. ..	4 12 3	1 3 3	2 14 3	2 5 0	13 15 0	11 0 9	34
7	6 cwt. super., 1 cwt. pot. sulph., 1 cwt. ammon. sulph. ..	4 14 0	1 5 0	3 9 9	2 15 10	15 0 0	11 10 3	36
8	3 cwt. market garden manure ..	4 5 3	0 16 3	1 8 6	1 13 4	10 1 0	8 12 6	24
9	3 cwt. basic sulph...	4 8 2	0 19 2	0 19 6	1 0 0	11 14 0	10 14 6	28

Wheatsheaf.

The trials at the Wheatsheaf station were practically ruined last season owing to a very hot spell at planting time. The germination was very poor and irregular, only sixteen plants per chain being harvested. Such being the case, the figures are of little value. They are therefore merely recorded.

TABLE VII.—RESULTS OF POTATO MANURIAL TRIALS AT WHEATSHEAF.
(On farm of Mr. Jas. Gooch.—Heavy red volcanic loam.)

Plot	Manure per Acre.	Market Size Tubers.	Increase due to Manures.	Cost of Manure.	Cost per Ton Increase.	Increased Value per Acre.	Net Increased Value.	Percentage Increase.
		T. c. q.	T. c. q.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	%
1	2 cwt. super. ..	1 13 3	1 6 2	0 12 6	0 9 10	15 18 0	15 5 6	371
2	3 cwt. super. ..	1 13 3	1 6 2	0 18 9	0 14 5	15 18 0	14 19 3	371
3	4 cwt. super. ..	1 10 0	1 2 3	1 5 0	1 2 7	13 13 0	12 8 0	314
4	3 cwt. super., 1 cwt. sulph. ammon. ..	1 13 3	1 6 2	1 15 6	1 7 0	15 18 0	14 2 6	371
5	Nil	0 7 1	..	..	..	..	..	..
6	6 cwt. super., 1 cwt. sulph. ammon. ..	1 13 3	1 6 2	2 14 3	2 2 3	15 18 0	13 3 3	371
7	6 cwt. super., 1 cwt. sulph. ammon., 1 cwt. pot. sulph...	1 11 1	1 4 0	3 9 9	2 18 3	14 8 0	10 18 3	342
8	3 cwt. market garden manure ..	1 4 0	0 17 3	1 8 6	1 11 8	10 13 0	9 4 6	253
9	3 cwt. basic phos. ..	1 1 3	0 14 2	0 19 6	1 7 2	8 14 0	7 14 6	206

DISEASES OF SHEEP.

By W. D. Shew, B.V.Sc., Veterinary Officer.

Balanitis or Pizzle Disease of Wethers.

Balanitis is an infection of the urethra, due to the presence of a micro-organism, or minute germ. The disease is infectious, and flies probably carry the contagion from one sheep to another. In many flocks the complaint is a very serious one, for affected wethers rapidly lose condition. They attract flies, and as the urine is not directed away from the belly, their wool remains wet and soon becomes badly stained.

The wool should be clipped away from the orifice of the sheath, and the clipped area thoroughly cleansed with an antiseptic solution, such as lysol, one teaspoonful to one pint of water. A lotion composed of washing soda, one teaspoonful to one pint of warm water, or a 1-1,000 solution of perchloride of mercury in water should then be injected into the sheath to thoroughly wash out all discharge. This treatment should be repeated daily in bad cases. In very bad cases the sheath should be slit with a sharp knife or scissors, and suitable antiseptics applied; this treatment, however, is not recommended except in cases of extreme urgency.

It is advisable to keep, as far as possible, the wool clipped away from the sheath orifice, so as to prevent the collection of urine and the matting of wet wool which tends to harbour germs.

Swelled Head in Rams.

In various parts of Australia cases of "swelled head" in rams occur from time to time. For a long while the trouble seemed to be of rather obscure origin, and many theories were advanced as to its cause.

Recently, however, Dr. L. B. Bull, D.V.Sc., Bacteriologist to the Adelaide Hospital, investigated the disease, and he has apparently solved its etiology.

The disease, he states, is essentially bacteriological, i.e., it is caused by the presence of a minute bacillus or germ, the *b. œdematiens*. In affected sheep this germ has been found under the skin of the swollen tissues of the head, where it had gained access through a wound. Dr. Bull has been able to produce the disease experimentally by injecting the causative organism under the skin of the head of a healthy sheep. Within 60 hours after injection swelling of the head and face had commenced. On opening this swelling a pale yellow fluid was found beneath the skin, and also in the chest cavity, just as in cases occurring naturally.

In nearly all outbreaks of the disease only young rams are affected —rams from six to eighteen months of age. Cases in old rams, ewes, and wethers have been reported, but unfortunately in none of these cases has the diagnosis been confirmed by bacteriological examination.

Affected rams show an œdematous swelling of the head and face which develops fully in from 12 to 24 hours after commencement, and death as a rule ensues in two or three days, although in a small percentage of cases recovery may take place.

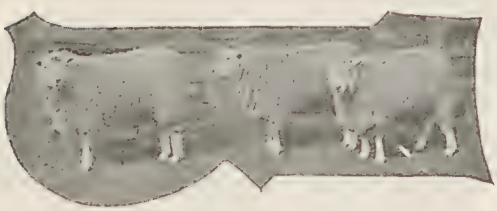
The organism gains access to the underlying tissues through a wound in the skin of the head. As a rule, only young rams are affected, and this is probably accounted for by the fact that these young animals frequently indulge in fighting and playful butting, particularly in that portion of the season when food is plentiful, or when they are reaching sexual maturity. This also no doubt explains the seasonal incidence of the disease.

Treatment.

If affected rams are not of much value, the best course is to destroy them and burn the carcasses. More valuable animals may be treated by making incisions in the swellings, to allow thorough drainage and access of air; the affected tissues should then be thoroughly cleansed with a suitable antiseptic lotion such as 1-1,000 solution of perchloride of mercury in water, or peroxide of hydrogen, one part to four of water; this should be repeated daily until recovery takes place.

Where the disease is prevalent, it is advisable to clip the wool from the head of each affected animal, and paint the skin with strong tincture of iodine, or some strong antiseptic lotion.

Investigations are at present being carried out into the preparation and use of a suitable vaccine to render sheep immune to this disease, but they are as yet incomplete.



REDUCTION OF NATURAL SHELTER AND ITS INFLUENCE ON WILD FAUNA.

Gilbert White, who published his evergreen *Natural History of Selborne* in 1789, at the time of the French Revolution, was like Darwin in his appreciation of the linkages or inter-relations between living creatures, and in his vivid sense of the cumulative importance of minutiae. Both of these qualities are well illustrated by his famous letter on earth-worms, whose importance as soil-makers and soil-improvers he clearly recognized. But this was characteristic of Gilbert White's outlook—he had the vision of *the web of life*. In the heat of the day the Hampshire cattle stand in the forest ponds, and their dung, dropped into the water, forms a culture-ground for aquatic insects—a very welcome addition to the food supply of fishes in places where "the water is hungry and the bottoms are a naked sand." He quaintly adds: "Thus Nature, who is a great economist, converts the recreation of one animal to the support of another." How interested Gilbert White would have been in the modern disclosure of the part that Japanese cattle, standing in the water, play in the spread of the formidable human parasite called Bilharzia—but that is certainly another story.

Nothing lives or dies to itself. The naturalist of Selborne noted that troups of water-wagtails run about the cows that are feeding in moist low pastures, and pick up the flies attracted to the cattle, or the other insects disturbed by their hoofs. How interested he would have been in the now familiar fact that these water-wagtails check the spread of liver-rot in sheep, since they are particularly fond of the little water-snail (*Limnoeus truncatulus*), which is the host of the larval stages of the liver-fluke that causes the sometimes serious "rot."

In application of this central ecological idea of inter-relations, we wish here to illustrate the results that may follow the reduction of wild corners throughout the country. From the farmer's point of view there is, no doubt, much to be said for trimming hedgerows and doing away with weedy borders and wild corners in fields, for these are often the haunts and nurseries of insects injurious to crops. Nevertheless, the other side of the account must not be overlooked, that hedgerows and the like afford shelter or cover to birds and other creatures, many of which are conspicuously or inconspicuously the farmer's friends. The more garden-like a countryside becomes, the greater is the risk that useful components of the fauna will disappear for lack of shelter. Tidiness may easily be carried too far!

The Changes Going On.—Both Gilbert White and Charles Darwin realized, as we have said, the cumulative importance of little things; and this must be kept in mind in connexion with changes in the countryside going on to-day. A particular reduction of shelter or cover may seem quite trivial, but the sum-total of results, over a large area and for a long stretch of years, may be of far-reaching importance. Another preliminary caution is that there are few changes which are one-sided in their results; most are partly against and partly for human interests. We have no warrant for expecting that Nature—"friendly" as she often is—should always operate in man's favour.

Thus, while there are a few birds, like wood-pigeons, that are almost wholly on the minus side as far as agriculture is concerned, and while the great majority are almost altogether to the good, of not a few it must be said that if they do some harm, they also do much good. There are familiar and long-standing arguments, pro and con, in regard to such birds as rooks, such mammals as moles, such insects as wasps. In many cases, like the last-mentioned, the data are not yet abundant and precise enough to warrant us in saying to which side—for or against agricultural interests—the balance swings.

It is also to be noted that the spread of agriculture is in itself bound to have a nemesis by promoting artificial situations. The Colorado Beetle was of no great moment as long as it fed in Colorado on its original food plant, the Sand Bur Solanum, but when fields of potato (another Solanum) afforded abundance of appropriate food, and when field was joined to field across the United States, then there was a plague—still unconquered.

Reduction of Shelter.—The reduction of shelters includes (*a*) the extension of farm lands over corners which had long retained their natural wildness, such as furze-covered commons where birds like Yellow Buntings used to breed, or slopes where the Badger or Brock used to burrow (how many local names begin with Brock!); (*b*) the stripping and restriction of the old-fashioned big hedges, which used to shelter useful mammals like hedgehogs and useful birds like hedge sparrows; (*c*) the replacement of hedges by wire fences and stone walls; (*d*) the making of broad roads, at present so frequent, and in some cases necessary, the first stage being usually the removal of the often luxuriant strips on either side, and the substitution of covered-in drains for the old-fashioned ditches, in or about which many creatures had their home.

We must repeat that the ranks of the injurious are thinned as well as those of the beneficial; but there can be no hesitation in saying that, from the agriculturist's point of view, there is much to be said for such mammals as hedgehog, weasel, and shrews, and for such birds as thrush and blackbird, titmice and wheatear, robin and cuckoo. Scores might be added, which are more or less thirled to hedgerows and wild corners. Slow-worms, which are almost restricted to wild places, feed largely on slugs; lizards are mainly insectivorous; frogs and toads are all to the good; and all these are dependent for continuance on the persistence of appropriate wild shelter.

Old and New.—In old days the cutting down of forests meant the disappearance of many animals, such as the woodland reindeer and the elk, the beaver and the bear, the wolf and the lynx; and our present point is that the dwindling of copses, hedgerows and wild strips, which are the "forests" for many small creatures, is being followed—and that inevitably—by a reduction in our fauna.

It is true, no doubt, that the wild fauna of Britain has not, as a matter of fact, diminished *quantitatively* in modern times; but it has lost in *quality*. There has been a replacement of larger by smaller forms of life, and of the visible by the invisible. As Ritchie proves so convincingly in his great book, *The Influence of Man on the Animal Life of Scotland* (Cambridge, 1920), man "lops off the giants at the head of the scale, and adds pigmies at the bottom—insect marauders which enter unobserved and are often first noticed only when they

force themselves upon his attention in their myriads." To gain rabbits and rats, cockroaches and bugs, is no consolation for losing reindeer and elk, beaver and pine marten, bustard and crane. Of course, no one dreams of proposing to reinstate bears and wolves (fox-farms and the like being an entirely different proposition); but no one can doubt the agricultural danger involved in over-thinning the ranks of insectivorous birds and of small carnivores that check the multiplication of small rodents.

To continue to argue from the past to the present, the necessary spread of cultivation and the breaking in of waste land long ago involved many disappearances, like that of the Great Bustard (*Otis tarda*)—once as common as a wolf, and now as conspicuous by its absence—or that of the quail (*Coturnix coturnix*), once as common as now it is rare. It nests occasionally in Scotland, but more frequently in Shetland, where the "reaper" is still unknown. "There, after the manner of the old days, the scythe or the sickle still mows the waving corn, and the quail reaps the benefit of such peace as a primitive cultivation gives." The immediate point is whether what happened to the bustard and the quail is not now happening to the cornerake and, perhaps, also to the lapwing, best of "farmer's friends." It is not merely that these birds do not approve of reaping machines: there is a reduction of rough corners beside fields and of quiet places generally. Even when the hedge has gone, the partridge often finds a suitable nesting place in the rough growth beside a roadside wall, and on the outer side as well as on the inner! But even these residual strips are being reduced, and in proportion as things become "spick and span" the birds become scarcer.

We do not counsel the impracticable, for cultivation must needs become more extensive and more intensive; but it is a practical question whether there might not be more conservation of wild corners as sanctuaries for beneficial animals. Yet again, in all these balancings of pro and con, we must be jealously fair, and while there has been in some highly cultivated parts of the country a diminution of the finer butterflies, for instance, that used to be common, and this as the result of the elimination of the caterpillar's food plants from hedges and fallow strips, the same will be true in regard to many *injurious* insects. So the reduction of wild shelters cuts both ways.

But this all-round fairness is a little apt to lead us to be too optimistic; the ominous fact is that there has been a serious reduction of the native shelters for useful birds and beasts. Dr. Ritchie puts it well: "With the breaking in of the wild banks and braes—'the burnin' yellow's awa' that was aince alowe, On the braes o' whin'—the nesting sites for many small birds and the shelters for many small rodents and insectivores have disappeared, to the grievous reduction of their kinds." We have deliberately cited this reference to rodents as well as insectivores, though the rodents are the farmer's foes while the insectivores are his friends. Nature is very fair-minded; she is not prejudiced in favour of farmers.

Drainage Plus and Minus.—Another useful analogy may be found in the results of drainage, ancient and modern. In old times there were enormous tracts of Britain in the state of peat-bogs and fens. Curlew and bittern, water hens and snipe used to be at home in what is now Belgravia, and the same may be said of many a prosperous

farm. As drainage became common and effective, vast swamps were reclaimed for agriculture; and Britain lost its cranes and bitterns—the latter now happily returning to breed in the Norfolk Broads. This drainage had, of course, its plus side, for thousands of acres of swamp became farm land, and as drainage meant a reduction of pools suitable for mosquito larvae and fresh-water snails, there was a diminution of malaria or ague, once very common in Britain, and of liver-rot in sheep, still abundant in places where effective drainage is difficult. What happened in the past on a large scale is now happening in many places on a small scale. There is a reduction of ponds and pools, bogs, and ditches, and while this has its agricultural and sanitary value, there is no use trying to ignore the tax to pay.

Even on golf courses, which have their ecological aspect as reservations for wild life, there is a persistent tendency to reduce the "rough" and to dry up "the pleasant places of the wilderness"—all with the result that many wild flowers which once were common have now vanished, and that many birds, whose presence used to console the bad golfer, have said farewell. The inevitable nemesis comes, even to the well-entrenched golf club, when there are not birds enough to check the multiplication of daddy-longlegs and click-beetles, whose larvae, the "leather jackets" and wireworms, are so hostile to the turf. So far as we know, it serves little purpose to allow a pond-surrounding, swampy nesting-ground of black-headed gulls to become so dry that the birds abandon it; and one of the immediate results is that the adjacent fields, formerly so free from insect pests, thanks to the appetite of this useful species of gull, are no longer exempted. We do not pretend that this has been proved by a careful statistical correlation of the amount of swampy ground and water-surface, the number of gulls in the gullery, and the abundance of injurious insects in the surrounding fields—inquiries that take time and have also to be corrected in relation to weather, farming, and crops—but the observational impression is as we have stated.

Dr. Ritchie gives details of a very instructive history of black-headed gulls. They came (1) in 1892 or 1893, to a heather moss, with peat and moisture underneath, on the southern slopes of the Pentland Hills; (2) they were protected and encouraged by the proprietor, who fed his young pheasants on the gulls' eggs; (3) they nevertheless flourished, the last clutch being always left to hatch; and (4) they increased enormously till (1897) there were 1,500-2,000 pairs of birds. The grouse that used to frequent the heather disappeared. But with the extension of the gullery, the vegetation (5) underwent a noticeable change, the heather being replaced by abundant coarse grass, which was cut for hay, then by a dense growth of rushes, both (6) becoming almost choked by a forest of docks. Whereupon the villagers, angry at the destruction of their hay crop, made persistent raids on the gullery, and the proprietor, regretful at the disappearance of grouse, ceased to protect the gulls for his pheasants. In 1917 not more than 30 pairs nested, where a few years before there had been some 2,000 pairs. Then the vegetation began to change back again, (7) the docks and rushes giving way to rough grass and even to heather. Finally, the grouse began to return!

Roads and Horses.—We have referred to the trimming and broadening of roads with the resulting decrease of shelter, but there are two

other points to be considered. The modern road adapted to motor traffic has in many cases something in the way of tar-macadam or asphalting; and it is generally believed that the wash after rain is detrimental to the small animals in ditches and streamlets, and directly or indirectly to trout and salmon in the adjacent rivers. This may possibly mean the destruction of the young stages of some injurious insects, but it also implies a reduction of part of the food supply of insectivorous birds. It may be replied, however, that this will be far more than outweighed by the augmentation of insects implied in the increase of farm land with its abundance of suitable food plants. The issues are so manifold and criss-cross that it is next to impossible to predict the final result of more or less necessary changes; but the general proposition is this, that extensive crops afford super-abundant food to insect pests—such as turnip green fly, turnip moth, turnip saw-fly, turnip flea-beetle and diamond-backed moth; that a promiseful counteractive of these plagues is the multiplication of the birds which prey upon them; and that this implies a conservation of suitable shelter and cover.

The numbers of field insects must be incalculably greater than in old days, when agricultural operations were less extensive; and that ought automatically to mean more birds. Yet it may sometimes mean a disproportionate increase of certain types of bird, such as starlings, which are apt to drive away smaller insect-eaters, like wrens, robins, and warblers, which, moreover, are more dependent on the minor shelters like hedgerows, the starlings mostly roosting in trees.

Some birds that are largely seed-eaters, like the finches, may be beneficial to agriculture, inasmuch as they feed their young on insects. Thus the common yellow bunting or yellow hammer, which depends on seeds and small fruits in winter, is largely insectivorous in summer, and feeds its young on insects. The fact that it, like the hedge sparrow, is also fond of spiders, may be noted as an instance of the difficulty of balancing pros and cons, for spiders are very useful in checking the multiplication of small insects.

In many parts of the country where the yellow hammer used to be very common, there is now a marked scarcity. This is ascribed by some to the fact that there is of recent years so little horse dung on the roads; it used to be a common sight to see the yellow hammers picking up the undigested grains of oats.

In conclusion, it is quite certain that the food of many wild birds consists largely of injurious insects which are a continual menace and involve a huge annual loss which our country can ill afford. Thus there might be mentioned from the long list the following representative birds: titmice, lapwings, hedge sparrow, redbreast, skylark, thrust, wagtail, warblers, pipits, and flycatchers. These and scores of other birds are worthy of preservation on grounds of utility—let alone higher values—and one way of securing their survival is to refrain from being over-zealous in doing away with more or less harmless shelters.

—By J. Arthur Thomson, M.A., LL.D., Professor of Natural History, University of Aberdeen, in *Journal of the Ministry of Agriculture,* pp. 609-615, England, October, 1929.

STALLION REGISTER, 1929-30.

Under the Horse Breeding Acts 1919-1925.

Part III.*– Registrations from 1st September to 31st October, 1929.

Cert. No.	Name.	Age.	Class.	Owner.	Address.
		Yrs.			
647	Abdullah King ..	A	Pony ..	E. Eagland ..	Seymour
672	Admiral Roy ..	3	Light ..	H. A. Kent ..	Albert Park
734	,, Sperry ..	A	Draught ..	D. Mathieson ..	Waitchie
612	Allandale ..	A	,, ..	S. A. Burdett ..	Hopetoun
670	Aussie Diblitz of Fenwick	3	Pony ..	Mrs. D. Maclean	Yan Yean
609	Axedale Prince ..	A	Draught ..	J. McDonald ..	Ultima
664	Barney ..	A	Pony ..	C. Cameron ..	Henty
634	Baron ..	A	Draught ..	W. Maguire ..	Barwidgee Settlement
730	,, Brilliant ..	A	,, ..	M. P. Murphy ..	Rupanyup
635	,, Douglas ..	A	,, ..	Jno. Petrie ..	St. Arnaud
635	,, Fyvie ..	A	,, ..	M. Shields ..	Youanmite
709	,, Style ..	A	,, ..	J. P. Belleville ..	Watchem
716	Beaconsfield Flyer	A	Light ..	P. Cousins ..	Gapsted
701	Berra Bach ..	A	Pony ..	Kroker and Hastings	Horsham
613	Bold MacGregor ..	A	Draught ..	Doherty and McCarthy	Walpeup
659	Bonnie Belmont ..	A	,, ..	J. T. Watkins ..	Euroa
648	,, Voyage ..	A	Light ..	J. E. Tanner ..	Barnawartha
706	Border Prince ..	A	Draught ..	N. S. West ..	Corop
715	Brighams Pride ..	A	Pony ..	S. Christopher ..	Mansfield
615	Britons Bold ..	6	Draught ..	F. W. Lennecke ..	Dotpa
693	Captain Douglas ..	A	,, ..	C. S. Rodda ..	Warracknabeal
624	Carluke ..	4	,, ..	H. McCluskey ..	Strathmerton
668	Cliffdale ..	3	,, ..	R. J. Thomson ..	Brim E.
733	Clyde Bank ..	6	,, ..	Jno. Hannon ..	Swan Hill
685	Colonel Garfield ..	A	,, ..	Millard Bros. ..	Dean's Marsh
606	Corrong Chief ..	A	,, ..	E. Uebergang ..	Roseberry
622	Cruncher ..	A	,, ..	Trustees, Moore Hunter Estate	City Horse Bazaar, Melbourne
718	Cymbrel ..	A	Light ..	S. Hancock ..	Poowong
722	Dalmore Again ..	A	Draught ..	J. A. Todd ..	Beulah
631	Dandy Lad ..	A	Pony ..	Stuckey Bros. ..	Flynn
710	,, Luck ..	A	,, ..	Mrs. M. Johnson	Doreen P.O.
654	Don Huon ..	A	,, ..	W. Pertzel ..	Drouin
707	,, Tourie ..	A	Light ..	J. Dillon ..	Bannerton
692	Douglas Chief ..	A	Draught ..	D. Trewick ..	Elmore
684	Duddon ..	A	Thoro'bred	A. P. Wall ..	Glen Alvie
731	Duncan Stewart ..	A	Draught ..	F. G. Fitzpatrick	Heyfield
719	Earl Direct ..	A	Light ..	F. McClelland ..	Boort
639	Erigator ..	A	Draught ..	P. Green ..	Rochester
652	First Voyage ..	A	Light ..	W. J. Minns ..	Melton
736	Gallant Jock ..	A	Draught ..	W. Hooper ..	Bungeluke
695	General Foch ..	A	,, ..	T. Algie ..	Nyah W.
626	,, Harvey ..	A	,, ..	H. E. Byron ..	Woomelang

* Parts I. and II. were printed in this *Journal* for August and October respectively.

STALLION REGISTER, 1929–30—*continued.*

Cert No.	Name	Age.	Class.	Owner.	Address.
		Yrs.			
616	Glengarnock ..	A	Draught ..	B. McKenzie ..	Bass
650	Grampian Lad ..	A	,, ..	E. P. Kealy ..	Edenhope
644	Grand Opera ..	3	Light ..	J. J. Guidice ..	Kangaroo Flat
704	Hero's Lad ..	5	Draught ..	Wm. Fowler ..	Rangie
689	Hillhead Knight ..	A	,, ..	H. W. Pannowitz	Diapur
650	Interest ..	A	Pony ..	A. Kennedy ..	Arcadia
638	John O'Dale ..	4	Draught ..	J. C. Dufty ..	Lorquon W.
679	Kelm Pride ..	A	,, ..	C. Lippiatt ..	Scotsburn
605	Ken's Pride ..	6	Pony ..	H. McMeekin ..	Kyneton
702	Kilmore ..	A	Draught ..	W. Gribence ..	Orbost
633	King John ..	A	,, ..	A. Cail ..	Kamarooka
661	King's Pride ..	A	,, ..	Jno. Rose ..	Pakenham
739	Kingston ..	A	,, ..	R. P. Nicol ..	Yarram
607	Kitchener's Pride	A	,, ..	A. Cheesley ..	Barnawartha
691	Lawrence Drew ..	3	,, ..	D. Williamson ..	Wendouree
665	Little Leo ..	A	Pony ..	Mrs. A. Bray ..	Croydon
641	Lonsdale Again ..	A	Draught ..	W. L. Leighton	Yarram
671	Lord Lulu ..	A	Light ..	F. C. Lord ..	Junee, N.S.W.
629	Lymm Loden ..	A	Draught ..	A. F. Emery ..	Tarnook
667	Magic Railway ..	A	Pony ..	Mrs. J. Wilkin ..	278 Toorak-road, South Yarra
720	Major Again ..	A	Draught ..	D. H. Coutts ..	Minyip
632	Maori	A	,, ..	K. Müller ..	Carwarp
732	,, Jack ..	A	,, ..	A. Potter ..	Naroghid
618	Marcellus II. ..	A	,, ..	Forrest Bros. ..	Port Fairy
677	Maritimus ..	A	,, ..	T. J. Opie ..	59 Sackville-street, E. Kew
676	Marvel of Earlshall	6	Pony ..	R. J. Maclellan ..	Walsh-st., S. Yarra
620	Masterdale ..	5	Draught ..	T. F. Kerr ..	Koroop
687	Maurite ..	A	Light ..	O. S. Ovens ..	Tatura
681	McKenna of Shetland Heights	4	Pony ..	Miss Small ..	241 Dandenong-rd., Windsor
642	Merry King ..	A	,, ..	J. Dellora ..	Sth. Wangaratta
700	Montrose ..	A	Draught ..	McNaughton Bros.	Wycheproof
682	Newfield's Pride ..	A	,, ..	J. M. Martin ..	Aubrey-road
711	Newton Style ..	A	,, ..	E. Coad ..	Cobden
608	Onward Star ..	A	,, ..	R. Williams ..	Dumbulbalano
645	Opera Boy ..	5	Light ..	J. J. Guidice ..	Kangaroo Flat
675	Othon	5	Pony ..	W. Good ..	49 Canterbury-road, E. Camberwell
653	Oxford	4	Draught ..	A. E. Capron ..	Lethbridge
703	Palos	A	Light ..	R. Warren ..	West Moolap
717	Patriot II. ..	A	Draught ..	J. W. Ewing ..	Penshurst
678	Patrus	A	Thoro'bred	R. Biggar ..	Waaia
623	Pedlar	3	Draught ..	McQueen Bros. ..	Waubra
721	Peter Eden ..	A	,, ..	Jno. Dwyer ..	Bonambra
660	Preble ..	A	Pony ..	A. F. McKenzie	Hexham
658	Premier Jack ..	A	Draught ..	V. Vaughan ..	Condah
657	Prince Ecuador ..	A	Thoro'bred	F. Hender ..	Broomfield
627	,, Wigton ..	A	,, ..	Wm. Studman ..	Bairnsdale
611	Real Scotch ..	A	,, ..	W. G. Pharoah ..	Warragul
683	Richard III. ..	A	Pony ..	A. Ruttle ..	Inverloch
688	Right Dale ..	A	Light ..	O. S. Ovens ..	Tatura
617	Robinhood ..	A	Draught ..	J. McKee ..	Clarendon
669	Roseleaf ..	4	,, ..	A. Bannerman ..	Brim
628	Roseworthy ..	A	Light ..	E. Allen ..	Ondit

STALLION REGISTER, 1929-30—*continued.*

Cert. No.	Name.	Age.	Class.	Owner.	Address.
		Yrs.			
694	Roy	A	Pony ..	J. B. Cleeland ..	Newhaven, Phillip Island
643	Royal Belmont ..	4	Draught ..	W. A. Creighton	Alexandra
640	,, Dale ..	5	,, ..	M. Kennedy ..	Winslow
680	,, Flush ..	A	,, ..	Jno. Booth ..	Glenormiston South
662	,, Hero ..	A	,, ..	W. Christensen ..	Traralgon
708	,, Mac ..	A	Light ..	Charity Bros. ..	Serpentine
637	,, Robin ..	A	Draught ..	A. Hando ..	Woosang
651	,, View ..	A	,, ..	S. Landers ..	Salisbury
690	Scotch Mixture ..	A	,, ..	W. Mitchell ..	Woomelang
610	Scotchie ..	A	,, ..	I. Kelly ..	Korong Vale
713	Scotland Again ..	A	,, ..	Jas. Mulholland..	Eurobin
705	,, ,, ..	6	,, ..	A. McDonald ..	Mt. Wallace
738	Scotlands Bloom	A	,, ..	R. Rogers ..	Natimuk
723	Scottie	A	,, ..	T. Fullam, jnr. ..	Torrumbarry
699	Seymour ..	A	,, ..	J. Cleeland ..	Newhaven, Phillip Island
656	Siam	A	Light ..	C. Calaby ..	Ararat
646	Sir Dillon ..	A	,, ..	C. A. Lesser ..	Coleraine
698	,, William ..	A	Draught ..	W. A. McClellan	Bungaree
619	Soldier Boy of Fenwick	5	Pony ..	Miss S. Robinson	Bulleen-road, East Kew
728	Southern Star ..	A	Draught ..	J. Maher ..	Rynaby
696	St. Mark ..	A	,, ..	C. W. George ..	Beulah
621	Stryver ..	6	,, ..	Jno. Elliott ..	Kyabram
724	Surprise Journey..	6	,, ..	Wm. Balloch ..	157 Auburn-road, Auburn
649	Surrydale ..	3	,, ..	J. A. Hinton ..	Vite Vite
714	The Globe ..	A	Light ..	J. Barker ..	4 Woolacott-street, Coburg
740	Theale Padlock ..	A	Draught ..	W. McLeod ..	Lucknow
778	Tinylights ..	A	Pony ..	T. Stokes ..	44 Brougham-street, North Melbourne
697	True Blue ..	A	Draught ..	W. J. Wilson ..	Drik Drik
596	Weston Hero ..	A	,, ..	A. G. Gordon ..	Broughton
663	Widgiewa Blackwood	6	,, ..	A. Gillies ..	312 Racecourse-rd., Newmarket
673	Wunnamurra Silver Dale	3	,, ..	J. Mills and Sons	Finley, N.S.W.
674	Wunnamurra Silverstroke	4	,, ..	J. Mills and Sons	Finley, N.S.W.
625	Yeneda ..	A	Thoro'bred	P. O'Loughlin ..	Noorat
727	Young Lad ..	A	Pony ..	W. H. Gillett ..	Lara
725	,, Shepherd ..	A	Draught ..	Exors. R. Young	c/o Young Bros., Minyip

ENGLISH FARMING.

A LESSON FROM HISTORY.

The authority of established practice, nowhere more firmly grounded than in the agricultural community, has continually been questioned by writers and theorists, or practical men who differed from their neighbours on the best methods to employ. Improvements of all kinds have been made in the passing centuries, but only at exceptional periods and in isolated instances have the necessary changes demanded by immediate circumstances been made sufficiently quickly. When an antipathy to change, readily understood because of the nature of farming operations, is general, it must be difficult for those who are using an improved method to believe that that improvement in its turn can be bettered in the face of adverse circumstances. The Norfolk four-course system, growing, as it did, out of the introduction of new crops, the turnip and clover in the late seventeenth and early eighteenth centuries, has now become so firmly established a tradition that it seems incredible that it could be changed with any advantage to the farmers in the eastern counties. Let us, however, examine the circumstances in which this system grew and flourished, and let us see what manner of reception it had from those who were known as "improvers" in the eighteenth century, and what were the practical alternatives to its adoption.

During the whole of the eighteenth century the demand for wheat was steadily increasing, and farmers were doing their utmost to cope with the demands of a population which was not only growing rapidly, but whose taste for wheaten flour was increasing equally rapidly. During the century the population doubled, and the increase was more pronounced in the third and greatest in the last quarter of the century: moreover, a larger proportion of the people were eating bread made of wheat alone at the end of the century than at the beginning. Imports of wheat were practically negligible until the turn of the century.[1] All these circumstances made it profitable to grow wheat in this country, and the inclosures were mainly directed towards increasing the wheat acreage and introducing improved rotations that would enable wheat to be sown more frequently and with a prospect of improved yields.

In the eastern counties the change was very marked, because it was here that the earliest turnips were sown and the greatest advantage taken of the red clover crop introduced from Flanders in the seventeenth century. "For thirty years," says Arthur Young, "from 1730 to 1760,

[1] See Ernle: *English Farming, Past and Present.*—The yearly average imports were as follow:—

1765-74	53,000	quarters.
1775-84	60,000	„
1785-94	71,000	„
1795-04	615,000	„
1805-14	577,000	„

The highest of these figures represents about one-tenth of the annual consumption estimated by contemporaries. Until the "'sixties" there had been a small exportable surplus, although the influence of the bounty on exports may have caused export when there was no true surplus.

the great improvements in the north-west of the county (Norfolk) took place, which rendered the county in general famous."[2]

What were these improvements? Were they directed towards the establishment of the four-course system? We read in Thomas Hitts' *Treatise on Husbandry; or the Improvement of dry and barren lands*[3] that " Barley may be sown on denshired land which will produce plentiful crops of corn and clover for three to four years and be in rich order for grass," while, on the following page, he says that Rockliff ploughs are used for paring in Lincolnshire. The process of denshiring was to pare off the turf with a breast plough, to allow the turves to dry and then burn them and scatter the ashes for manure; it was common to heath and fen land in many parts of the country. This system of paring and burning heathy land and taking several crops afterwards, either letting the land fall down, or sowing grass, was customary in Kent at this time[4]; it was also followed on the High Wolds of Yorkshire.[5]

This was, of course, some years before Coke of Norfolk began the work at Holkham for which he is so justly famous, and which is supposed to date from 1778: one of his first improvements was to abandon the local custom of three white crops in succession, and to take only two, keeping the land in grass for the two following years.[6] It would, therefore, seem that in the eastern counties, whose agriculture Young was so fond of placing before the country as a pattern of excellence, the four-course system, however general, was not universal.

Young himself, writing reports on the agriculture of Suffolk (1797), Lincolnshire (1799) and Norfolk (1804), for the old Board of Agriculture, gives a multitude of rotations, which were observed by the farmers of that time. He even goes so far as to say of one farmer in Norfolk that he was using " the old four-shift."[7] The occurrence of 2-year leys is noted in this county as common in the rotations at Knattishall and Snetterton; at Eggmore and South Walsham, where a mixture of white clover, trefoil and rye grass was sown; at Oxnead, where the course had included 2-year leys in a six-course rotation since 1773, and was common throughout the country; at Thurning, he thinks the course would be improved if the 2-year ley were left down for an extra year; and, at Summerfield, Mr. Dursfield, who farmed 1,050 acres, had 2-year leys in those fields where he did not use 3-year.[8] It is true that Young admits that, on the stronger land, the ley did not figure so largely,[9] but he notes that one Drosier of Rudham, thinks that the greatest improvement would be to lay the land down for eight to ten years to repose the land from turnips and corn,[10] and that Overman includes 3-year leys and 2-year leys in his courses. In Suffolk

[2] County Report, *Norfolk*, 1804, p. 31.
[3] 1760, p. 126.
[4] John Mordant: *The Complete Steward*, 1761, p. 141.
[5] G. Hunter: *Georgical Essays*, 1770, I. 196 ff.
[6] A. M. W. Stirling: *Coke of Norfolk and his friends*, 1912, p. 158. Earl Spencer: *Jour. R.A.S.E.* Vol. III, 1842, p. 3.
[7] County Report, p. 210.
[8] *id.* pp. 194-201.
[9] *id.* p. 212 ff.
[10] *id.* p. 195.

the poor sand lands were sown with trefoil and rye grass and left down from two to four years after turnips and barley, while the bad farmers are reproved for being in too great a hurry for corn and an immediate advantage (wheat was bringing very high prices in the war years) which caused them to plough too soon. In the Fens it was common to pare and burn, to take oats twice, and leave the land in grass for six or seven years, then repeating the process.[11]

The same incidence of two-, three- or four-year leys is noted in Lincolnshire,[12] and it was not only in practice, but also in the writings of the "book farmers" that this system was advised at that time. Robert Brown, of Markle in Haddingtonshire, a well known farmer and writer, goes so far as to quote and applaud the justness of the views of Blyth on the subject. This is the more surprising as Blyth was writing about 1650, or some 160 years before Brown's *Treatise on Rural Affairs* appeared. Brown has nothing but approval for Blyth's view that land should not be kept too long in pasture, especially heavy, wet land, but should be "renovated with tillage, and after being cropped five or six years, sown down with grass seeds. . . ." "On the other hand," he adds, "Mr. Blyth appears to have possessed an accurate notion of the evils flowing from over-ploughing, or in other words, from keeping land too constantly under tillage, a system too prevalent, even now, in many English counties."[13]

The alternate husbandry had been in existence alongside the two- or three-crop and fallow system of the common fields for a very long time in many parts of England. It was the practice on "clay or light mould inclosures" and on temporarily inclosed heath land in Staffordshire in 1686,[14] and was used on the downs of Wiltshire and in the inclosures of Stafford, Leicester and Northampton in 1726.[15] A 2-year ley was also recommended as desirable in newly broken up "sward" at the same time.[16] At Ryhope, near Sunderland, also, leys of five or six years are recorded by George Bailey.[17]

At Holkham, as we have seen, Coke of Norfolk had introduced a system of 2-year leys; we learn that by 1850 the four-course rotation was followed throughout the district; that on the heavy lands in Suffolk the course prescribed by the leases was the four-field, and that the same was true of West Norfolk.[18] In the latter district Caird discussed with the most intelligent and experienced farmers the question of how far the system continued applicable, and found the general opinion to be that it was no longer necessary or expedient, because facilities for obtaining artificial manures were so much greater at that time than they had ever been. Where a man was not restricted by rigorous covenants, or farmed his own land, the system was departed from. Ten years before Caird made his survey, Barugh Almack had stated that while the four-course system was general in almost every part of the county, the

[11] County Report, pp. 39-42.
[12] County Report, pp. 96-106.
[13] *Treatise on Rural Affairs:* 1811, Vol. I, pp. 15 and 16.
[14] Robert Plot: *The Natural History of Staffordshire*, pp. 107 and 108.
[15] John Laurence: *A New System of Agriculture*, 1726, pp. 68 and 83.
[16] *id.* p. 66. See also Thomas Hitt, op. cit., p. 125.
[17] *Annals of Agric.*, 1786, V., pp. 361-2.
[18] James Caird: *English Agriculture in* 1850-51, pp. 153, 168, and 176.

marshes and fens were farmed on a different rotation, which "would be the case more generally if each person cultivated his own land."[19] One farmer, Neave of Downham Grove, near Saxmundham, had even expressed the opinion that he would prefer to introduce a two-year ley into his rotation.[20]

In Lincoln the 2-year ley had continued to find favour. Among many varied courses it was to be found on the Wolds, on the Heath and on the clay near Spilsby, while on the Carrs, the land was under the plough for a few years and then went back to grass. At the same time the four-course system was practised on many thousands of acres on the Wolds.[21]

It is doubtless easy to emphasize the divergencies from custom, but it is well to bring out the fact that the four-course system was largely imposed from above, and that even as late as the middle of the nineteenth century it had its critics. Economic changes brought about the extension of the system, which was regarded as the most approved form of husbandry.

The heavy land of Suffolk had been famous as dairy land for centuries. The cheese was not so good as Cheshire, but the butter was sent to London and elsewhere and was generally commended. The dairy industry, however, fell on bad days: on the one hand, butter and cheese brought low prices because of the importation of Irish and Dutch products; on the other there was a difficulty in getting dairy servants. As a consequence the land was broken up, new leases were granted and the course of cropping thereafter varied but little over the county.[22]

In the depression of the 'seventies and 'eighties of last century, however, large tracts of the heavier soils of East Anglia were sown down or fell down to grass, and corn-growing once more gave place largely to dairying. For some centuries before 1849 the heavy lands of Suffolk had been stocked with a native breed of cows (light dun polls) noted for high yields and butter qualities,[23] so that dairying in East Anglia is not the recent innovation for which Scotsmen and Cornishmen are generally given the credit.

In view of the important part now played by milk production throughout the whole of East Anglia it is somewhat difficult to account for the oft-repeated statement that, owing to the dryness of the climate, good grass fit for dairying cannot be produced in that region. Instances of successful pasture formation, both ancient and modern, are by no means rare. The climatic conditions do not differ appreciably from those of the north-east seaboard, where short term leys are the rule rather than the exception; and while, in the south, summer heat may be slightly more intense and spells of drought somewhat more protracted, the heavier, more retentive soils characteristic of East Anglia are less subject to drying-out. For mid-summer shortage, the southern farmer enjoys a peculiar advantage in lucerne.

[19] *On the Agriculture of Norfolk:* Jour. R.A.S.E., V., 1844, pp. 320-1.
[20] *id.* p. 332.
[21] J. A. Clarke: *On the Farming of Lincolnshire,* Jour. R.A.S.E., XII (1851), pp. 332, 339, 347, 355, 330.
[22] Wm. and Hugh Raynbird: *On the Agriculture of Suffolk,* 1849, pp. 7, 111, 117, 121, 124.
[23] Raynbird, *op. cit.*

It is true that unimproved or impoverished pasture is of little account for dairying. That applies universally. The heavy soils of the region in question, however, provided they are not waterlogged, respond generously to dressings of readily available phosphate. Pastures, everywhere, lose in feeding value when parched, and, in such an event, nothing so well maintains milk yield as supplementary green keep.

Some of the methods practised about the middle of last century closely resemble those recommended to-day. In 1864 H. S. Thompson described[24] his own method of dealing with a poor, clay land farm. Having convinced himself that corn-growing alone would not pay, he had recourse to sheep. His plan was to buy in ewes in the autumn to run on the old grassland through the winter at the rate of about one to the acre. In ordinary seasons they maintained themselves without extra keep till Christmas, from which time they received a small feed of oats daily until lambing time. After lambing, turnips and mangolds, previously stored on the grass, were given them with corn or cake until the winter tares or clover was ready. Rape followed and, by continuing the corn or cake, all the lambs and most of the ewes were sold fat in time for the land to be prepared for wheat. From an average yield of 2 to 3 qrs. he states that the wheat crop soon rose to 4 and even 5 qrs. and the spring corn improved in proportion.

He records that the farm contained no grass good enough to fatten a bullock. "The previous plan had been to buy in young cattle in the spring, when most other graziers were doing the same, and when, consequently, in nine years out of ten they were bought dear. They had to be sold out again in the autumn when many other farmers were selling too; so that the tenant generally returned from the fair grumbling that he had scarcely got more than he gave for his stock and that his summer grass was all but thrown away." As an alternative, caking on grass was tried but without success. Thereupon, he bought yearling heifers in May and a young bull to run with them at grass. The bull was taken away in August and the heifers remained in the pastures until severe weather set in, when they were taken into a strawyard and given, once a day, a feed of roots "if there were any to spare": if not, 2 lb. of linseed cake daily. If in-calf heifers were very dear in the spring, he sometimes sold a few before calving for as much money as if they were prime fat: but the usual course was to let the calves run with their dams all the summer. When taken up in October, the calves were so fat "they looked like prize beasts in miniature." After keeping them well through the winter, "they were eagerly bought by the butchers in June when the winter-fed cattle had been nearly all slaughtered and the grass-fed had not yet come in." As for the heifers, a few that promised to be first-rate milkers were taken into the dairy; the greater part were sold for winter feeding and realized about £2 more than when bought eighteen months before. The calves generally realized £1 per month of age: one year, the whole lot averaged £16 each at fourteen months. Is this another case of history repeating itself?

As regards sheep, the trend nowadays is towards free-range rather than folding, so that grass would take the place of summer folding

[24] Jour. Roy. Agric. Soc., 1864.

crops. For grazing, new leys may have several advantages over permanent grass. They start growth earlier in spring and generally respond more quickly to forcing treatment: they are often superior in feeding value. Thus they are well adapted for the production of fat lamb at about fourteen weeks old. They may be grazed by ewes and lambs until the end of May and thereupon shut up for a leafy hay crop or, in suitable circumstances, for the harvesting of a crop of wild white clover seed. It is now generally recognized that genuine "once-grown" wild white is little, if any, inferior to seed off old, permanent pasture. What is, perhaps, less widely realized is the high feeding value of well-made leafy hay, and the part it can play in the replacement of costly feeding stuffs. After the removal of the hay or seed crop, the aftermath will quickly respond to rain and provide abundant leafy keep throughout the autumn and well into winter.

It is not suggested that this is the only way of exploiting a climate subject to spells of summer drought: it is, however, a method favorable to the spread and development of wild white clover, a plant constituting one of the best safeguards against drying-out and, perhaps, the most effective agent for increasing the fertility of arable land.

As an alternative, intermittent grazing may be suggested whereby a higher total yield will be obtained than under continuous defoliation, with its attendant risk of shortage should the entire pasture be caught bare when a dry spell sets in.

The general effect of increasing the proportion of grass on an arable farm is to diminish costs. Just as eggs, when danger threatens, are safer in several small baskets than in a single large one, so variety in a farming crisis is a safeguard against total loss. It is unnecessary to elaborate means of utilization or to discuss fully whether the grass shall be permanent or temporary. These things depend upon individual circumstances. Where, however, a principal object is the production of crops for sale, the temporary ley working round the farm, gathering fertility as it goes, is generally to be preferred. Questions, however, of water supply and fencing may sometimes determine otherwise. Our primary and main object is to show that modern seeds-mixtures sown under suitable conditions should not be ruled out as a possible means for mitigating the present stress even in the somewhat peculiar circumstances of East Anglia.

—Reprinted from the *Journal of the Ministry of Agriculture*, England.

AMERICA'S NEW FARM RELIEF MEASURES.

The following interesting article on the above subject has been contributed to *The Commercial,* Manchester, of 29th August, 1929, by Mr. G. W. Fooshe:—

"The Federal Farm Board created under the Agricultural Marketing Act passed by Congress has been given broader powers, according to President Hoover, than the Government of the United States has ever previously conferred upon any single agency. It is charged with the task of putting agriculture on a basis fairly comparable with that enjoyed by industry, and it has been provided with ample funds for this purpose. A total of $500,000,000 has been set aside for its use, and of this amount Congress has already made $150,000,000 immediately available. Furthermore, the Board has been provided with $1,500,000 for administrative purposes, and it will gradually build up a force of experts who will delve into every angle of the huge problem which confronts it.

In addition to these forces it will have the active co-operation of the United States Department of Agriculture, and the various bureaux operating under the Department, while it may call upon any other Department of the Government for assistance whenever it desires to do so. The Federal Farm Board may, therefore, be described as a sort of super-organization, not only because of the size of its task, but also because of the powers which have been conferred upon it and the facilities which have been placed at its disposal. How will it set out to accomplish the purpose for which it was created? What will be the effect of its activities on the price of farm products and on the welfare of the agricultural population and the live-stock interests of the United States?

These questions are of wide interest to consumers of cotton, grain, beef, and other farm products, as well as to those who are engaged in the growth and distribution of these commodities. Clearly, the position of agricultural interests may not be improved except through increasing the returns which they are enjoying, and this naturally raises the question of whether such returns are to be obtained without penalizing those to whom these interests sell. The Federal Farm Board is essentially a co-operative organization. This is perfectly obvious from the fact that all of its members, except Mr. Alexander Legge, its chairman, and Mr. Arthur M. Hyde, Secretary of Agriculture, are representatives of one or more co-operative marketing groups in commodities and live-stock. I was told some time ago that the Agricultural Marketing Act was primarily a co-operative measure, and that it was passed with the full sanction of the co-operative associations, if not largely in their interest.

Backing the Co-operative Movement.

It is, therefore, perhaps not surprising that, in outlining the plans of the Board in his address before the Institute of Co-operation, at Baton Rouge, La., on 30th July, Mr. Legge declared that the main policy of this agency in bettering the position of agriculture would be the 'expansion and strengthening of the co-operative movement.' In

doing this, he said, the Board would not supplant any of the Federal or State agencies now in existence, but would call upon these for all the co-operation they could give. However, he made it clear that one of the first operations of the Board should be 'to further the activities of established agencies in the co-operative field' as a means of bringing about greater co-ordination in both the producing and distributing sides of agriculture. He pointed out that the principal handicap to agricultural interests, as compared with industrial interests, lay in the fact that farmers operated largely as individuals, while those engaged in industry tended more and more toward group planning and thinking, and he is absorbed with the idea of largely eliminating this handicap through extending the co-operative movement to a point where individual effort in both agricultural production and distribution will give place to concerted or group action.

He emphasized the fact that individual farmers maintained little or no contact with world markets for their products, and that they controlled too little to be a real factor in making the terms under which their products were sold, but that, if they operated in large groups through the co-operative agencies, they would not only be kept better informed as to supply and demand conditions, but they would also control enough of a given commodity to entitle them to a voice in the price at which it should be sold. In other words, the co-operative agencies would stand as the connecting link between farmers and the markets in which their products were sold, while group selling would entitle them to a prestige which they could not hope to enjoy as individuals.

Efficiency in Marketing.

Mr. Legge also expressed the belief that the co-operative movement might result in better control of production, as well as in more efficient marketing. He declared that there was no advantage in increased quantity and better quality of agricultural output if this resulted in the creation of a surplus which tended to depress prices to an unprofitable point, and he suggested that co-ordination of effort through the co-operatives in the matter of planning acreage might prove most helpful. It should be observed, however, that his idea is that greater efficiency in marketing will do more to put agriculture on a sound basis than efforts at controlling production.

No Loans to Individuals.

Another definite indication that the co-operative agencies are to be the main bulwark of the Federal Farm Board is found in the fact that no loans will be made from the funds at its disposal except to established co-operative organizations. Application from individual farmers or live-stock men will not be given consideration. The co-operative associations are to be the link between farmers in the United States seeking financial aid and the newest arm of the Government designed to supply assistance in every way possible.

If the co-operative organizations now in the field, or still to be established, need funds for providing increased facilities for handling or storing the particular products in which they are interested, or for

taking care of surpluses temporarily withheld from the market, they will find the Board not only able but also willing to co-operate with them to the utmost. The co-operatives, especially the larger ones, have already established credit with financial institutions in the United States, and they have been able to finance their operations quite successfully. They will, no doubt, continue to secure funds in the open market, but the fact that the Federal Farm Board is in a position to render financial assistance when it is shown that this is desirable, greatly strengthens their hand when it comes to a question of raising additional funds.

Stabilization of Prices.

The Federal Farm Board has made it clear that it will not undertake to control prices arbitrarily, for the reason that such an effort is not only impossible, but also economically unsound. It will, however, attempt to stabilize prices, and it will use the co-operative agencies for stabilization purposes. Some changes in the structure of the co-operative associations may be necessary to facilitate their use in this way, but it is believed that they can be effected with comparative ease, particularly as the American Growers' Exchange—the clearing-house of the State cotton co-operative associations—and the other larger co-operative organizations have expressed themselves anxious to be in entire harmony with the Federal Farm Board.

Thus, while the Board will avoid any effort at arbitrarily raising the price level of agricultural commodities, including cotton, the belief is widespread that it will, through the methods already outlined, exert a favorable influence on commodity values. It is regarded as scarcely conceivable that the broad powers conferred on the Board should fail to lessen the depression experienced before when temporary surpluses existed, or to stimulate values when demand is somewhat in excess of supply. In addition to the actual support growing out of the activities of the Board, there is also the psychological effect that is inherent in its existence.

Causes of Depression in Industry.

One of the most encouraging points in the programme of the Board is that it will seek to bring about permanent improvement in the position of agriculture rather than to relieve distress appearing here and there. Mr. Legge emphasizes that a long-time constructive plan is far preferable to dealing with purely temporary phases, and that the decision of the Board to follow the previous course will give it more opportunity to find causes of depression in the industry and to remove them.

Board to Help Farmers to Help Themselves.

Since it completed its organization, the Board has moved rather slowly, and it declares its intention of continuing this course. It recognizes the hugeness of its task, and it also recognizes that it has a vast amount of data that must be digested before it is prepared to put practical plans in operation. It will proceed only as rapidly as the co-operatives are able to fall in line with its aims and purposes, but the rapidity with which these agencies are moving in this direction suggests

that, while the Board desires to avoid undue haste, its programme will unfold in time to be an important factor in the marketing of this year's cotton crop and some portion of its grain. The real purpose of the Federal Farm Board, as set out by Mr. Legge, is to 'help farmers to help themselves,' and every move the Board has made so far has been in the direction of so marshalling existing co-operative agencies that they shall be the means through which the problem of the individual farmer will be reached and solved."

THE WORLD WHEAT SITUATION.

In its monthly letter for August last, the Canadian Bank of Commerce states that:—

"At this time, the opening of the new wheat year, it is possible to discuss with some assurance certain factors influencing the world supply of wheat and the prospective volume of international trade in this commodity. The first item to be taken into account is the carryover of old wheat, which, as far as statistical records show (they are fairly complete in only a few of the many wheat-growing countries) seems to be about 150,000,000 bushels higher than on 1st August, 1928. Most of this surplus is in the United States; the Canadian carryover is now estimated as about the same as last year, owing to the fact that farm stocks of merchantable quality have turned out to be probably 10,000,000 bushels more than was estimated a month or two ago. Argentina and Australia are thought to have slightly larger supplies, and European stocks are also reported to be somewhat higher.

The increase in the world carryover this year is, however, completely overshadowed by the probability of a considerable reduction, possibly of 350,000,000 bushels, in the supply from the 1929 crops. The unfavorable crop conditions in Canada are fully discussed in the preceding section of this letter. The American crops, both of winter and spring wheat, have suffered severely during the last month or six weeks, and the total yield is not expected to be more than 800,000,000 bushels. India has a new crop this year of about sufficient proportions to meet her domestic needs, in contrast with the situation in 1928, when the yield was small and importations were necessary. Harvesting in one section of the Chinese wheat-growing area, the Yangtse valley, was recently completed, with disappointing results both as to yield and quality. The new crop in Japan is reported to be below that of last year. Conditions have been favorable for the major wheat-producing sections of Africa. It is regarded as reasonably certain that France and Spain will have larger crops than in 1928; the German and Italian harvests may be as good as last year, but the new crops in the Netherlands, Belgium, and Great Britain will be smaller. In Eastern Europe the extent of damage resulting from severe winter weather is now fairly well known, and the Danubian countries are likely to have crops about 50,000,000 bushels less than in 1928. Reports regarding the Russian situation are, as usual, conflicting. Droughty conditions in Argentina

indicate some curtailment in wheat planting this year, and dry weather in Australia has also probably prevented any increase in that country. The critical time for the crops in the Southern Hemisphere, however, is in September and October, and no definite prediction of the yield is now possible.

International trade in wheat during the next twelve months can hardly be expected to be of such great volume as in the 1928-29 season. It has been estimated that world consumption increases at an average annual rate of 70,000,000 bushels, but it varies, upward or downward, by as much as 100,000,000 bushels, depending on numerous factors, including the supply of domestic grains and imported carryover in the large importing countries and the price at which the latter can buy foreign wheat. In the preceding season most European countries had large crops of wheat, and their imports would have been less than in the 1927-28 season had it not been that feed grains were in short supply, which caused an abnormal use of wheat for stock food. The feed grain situation is not likely to be as acute this year and, if this should be the case and the wheat harvest favorable, the import requirements of Western Europe would be smaller than those of the year just closed. Furthermore, the Governments of Germany, France, and Italy have recently imposed new regulations with the object of increasing the use of home-grown wheat. An outstanding feature of last year's trade was the abnormal quantity of wheat bought by the Orient, owing in part to the large supply of low-grade wheat in Canada and the United States available at low prices. With smaller crops this year in North America and the Southern Hemisphere, and a higher price level, the Oriental demand will probably be of normal proportions. Taking all these factors into consideration, a total trade of from 800,000,000 to 850,000,000 bushels would seem a reasonable forecast."

ORCHARD AND GARDEN NOTES.

E. E. Pescott, F.L.S., Pomologist.

The Orchard.

Spraying.

The spray pump should now be in thorough working order, so that the various spring sprayings may be carried out with as little interruption as possible. It is always wise to clean out the pump after each spraying, so that it will be ready for the next mixture. Putting a different spray in a pump barrel that has not been washed out very often causes the formation of a sediment, which blocks the nozzle and interrupts the work.

During November it will be necessary to spray for codlin moth, peach aphis, pear slug, and various leaf-eating insects. In addition.

black spot of the apple and pear, shot hole, and other fungus diseases must be kept in check. As various sprays are required for all of these troubles, the necessity of always having a clean pump is evident.

At the present time the best spray for peach aphis is nicotine sulphate, and the same spray may also be used for the pear slug. Arsenate of lead is the better spray for this latter insect, but it should not be used when the fruit is approaching the ripening stage; hellebore may also be used for the slug with good effect.

As a preventive against codlin moth, the trees should be kept well sprayed with arsenate of lead and white oil. The first spraying should have been given at the time of the falling of the petals; the second spraying, owing to the rapid expansion of the fruit, should be given a fortnight later. After that the grower must use his own judgment as to the necessity for subsequent sprayings. If the moths be at all prevalent, other sprayings will be quickly necessary.

As the woolly aphis is increasing at this time of the year, it will mean a saving of a large number of buds if this insect be sprayed. Nicotine sulphate, pine spray, or lime sulphur may be used with good effect. Application should be made for supplies of the woolly aphis parasite, aphelinus.

Cultivation.

The work of ploughing and harrowing should be completed immediately. All crops for green manure should be now under cover, and if the orchard soil is at all heavy or stiff, the grower should make up his mind to grow a crop next season, in order that this condition may be reduced.

The orchard should be kept free from weeds, not only for the conservation of moisture, but in order to do away with all hiding places of the Rutherglen fly, cutworm moths, &c.

General Work.

Grafted and newly-planted trees should be frequently examined, and given an occasional watering and overhead spraying, in order to encourage their growth, and to prevent loss of moisture from the foliage. It is also advisable to mulch young trees with light grass, or straw mulching not too rich in animal manure.

The disbudding of unnecessary shoots and the pinching back or stopping of growths, to prevent their becoming unduly long, may now be carried out. This work is particularly important on young trees.

Graft ties should be examined, and the ties cut wherever any growth is being made. Where the grafts are likely to make any long growth, they should be well staked and tied.

Citrus trees may be planted out, and, after planting, they should be watered and mulched.

The Vegetable Garden.

Tomato plants should now receive attention every day; laterals will require pinching back; crowded bunches and shoots should be thinned; the plants should be well tied to the stakes, and liberal supplies of water

and manure should be given. One or two more plantings of tomato plants may still be made, so that there may be strong, sturdy plants for the production of late fruits. By planting three or four successions of plants, it is possible to have a good supply of fruits from December to June. Pull up and burn all plants showing any signs of disease.

Celery may now be sown for winter crops. French beans should be largely sown. Cucumber, melon, pumpkin, and all seeds of this family may now be sown in the open.

Where these plants are already growing, the longest and strongest runners may be pinched back, to throw the strength into flowering and lateral growths. Watch the plants for mildew, and use sulphur freely wherever present, especially on the young plants.

Peas, lettuce, radish, turnip, cabbage, and sweet corn seeds may be sown this month. Seedlings from former sowings may be planted out, and it would be well to dip the whole plant in water before planting. This greatly assists the young plants while taking hold of the soil in their new location.

Frequent waterings and frequent cultivation will now be necessary; and all weeds must be hoed or hand-weeded out; mulching with stable manure will greatly assist the plants.

A few beds should now be deeply worked, adding a liberal dressing of stable manure. These plots will then be ready for the celery, cabbage, and other seeds planted during this month.

The Flower Garden.

Continue to plant out the various bedding and foliage plants, corms of gladioli, and seed of such tender annuals as Phlox Drummondi, balsam, zinnia, nasturtium, celosia, aster, cosmos and portulaca.

While seeds planted out in the open germinate and grow fairly well, it is advisable during the summer months to plant these in sheltered seed beds, or in a canvas or calico frame. The protection need be on the one side only, preferably the west or north-west; the seedlings are then protected during the hottest part of the day. At the same time the shading should not be sufficient to unduly "draw" them.

The seeds should not be deeply sown, and all waterings should be light. A little water, often, should be the rule for seedlings. Annuals require plenty of room when planted out in the garden. Being quick growers, they are generally gross feeders, and they must have space to develop a good root system. Feeding, too, with liquid manure is helpful when they are reaching the flowering stage.

Dahlias may now be planted out, either from tubers or from young rooted cuttings. These will give good early summer blooms. For autumn and show blooms, the planting should be deferred until the middle of December.

Herbaceous and succulent plants should be staked for protection; included in this section are delphinium, gladiolus, perennial phlox, rudbeckia, &c. These plants will all benefit from liberal mulchings and watering with liquid manure when approaching the blooming period. Spring flowering bulbs, corms, and tubers should now be lifted and stored.

The soil surfaces will now benefit from frequent hoeings and stirrings. Constant waterings will be required if the weather be hot or windy, the cultivation should quickly follow the waterings in order that the moisture may be thoroughly conserved. Mulching with stable manure is also beneficial at this season.

REMINDERS FOR DECEMBER.

LIVE STOCK.

HORSES.—All farm horses in constant work at this season should be well fed with last year's chaff or a mixture of old and new, to which a liberal supply of oats has been added. New chaff or hay alone is not recommended, as it has not the sustaining powers of old hay, and is liable to give rise to digestive troubles. Horses require water at frequent intervals; keeping them for a long time without water, and then allowing them to drink to excess is injurious.

An occasional feed of green stuff will be beneficial. In the event of this being unobtainable, give at week-ends a bran mash, to which is added five or six packets of Epsom salts.

Mares which are away from foals for any length of time should have a portion of milk taken from them before foal is allowed to run with them, otherwise serious results may accrue to foal. Good results follow an allowance of chaff and oats to mares and foals running in paddocks, more especially where feed is short.

At this season the Bot Fly is about, and horses should be frequently examined for the eggs of this fly. The neck, forelegs, and jaws are the parts where the eggs are deposited. Either the use of the singeing lamp under affected parts or the application of kerosene will destroy the eggs.

CATTLE.—The harvesting season is now at hand, and herd-welfare in the future is going to depend largely on the use farmers now make of existing surplus growth. Opportunity to conserve grass and clover, either as hay or ensilage, will occur in many places and should be availed of as an insurance against future seasonal deficiencies. The oat crop should now be turned into ensilage or the next best substitute, hay, with a view to ensuring unfailing continuity of fodder—the dairyman's raw material—in any future emergency. Falling milk yields, due to seasonal pasture deterioration, may be expected on many farms, and supplementation with hand feed to the extent of the deficiency will be found good business, wherever the cows are true dairy animals. So sustaining the yield will not only pay for itself at the time, but will enhance the response from the green summer crops when they become available, inasmuch as they will be fed to still fresh cows instead of stale. For a summer roughage (short of green grazing crops) there is nothing like ensilage. In moister districts, summer crops such as Japanese millet, maize, and the sorghums may still be sown. See that the herd has access to good drinking water, as convenient as possible; no matter what supply there is in the paddock, a trough of water right at the cow-yard is never out of place for summer use at least. The better the cows, the more they need this consideration; remember milk is 87 per cent. water. Continue to deliver the cream with the necessary frequency, and counteract the damaging effect of high temperatures by cooling from the separator. Protect milk and cream from access of flies—even one fly more means many additional germs.

PIGS.—*Sows.*—Supply those farrowing with plenty of short bedding in well-ventilated sties. Those with litters old enough may be turned into grass run. *All* pigs should be given a plentiful supply of clean water. Read Bulletin No. 16. Pig raising and fattening with present price of pollard and grain should be profitable, as market prices for pigs are satisfactory. All young boar pigs intended for pork or bacon should be castrated during the first six weeks. All instruments used should be scrupulously clean. Dirty knives mean the formation of abscesses, and frequently portion of the ham has to be cut away. This is a considerable source of loss in many factories.

Sheep.—Shearing should now be over except in the case of a few late lambs in the wetter parts of the State. All faulty-mouthed ewes should be disposed of as fats; if not fat they should, if possible, be fattened for sale. Inferior-fleeced ewes should also be sold.

December, January, February, and March are the joining months, the time varying with climatic conditions of different districts. Lambs will be dropped 150 days after service. It is a mistake to try to lamb down early in the later districts.

Leave the rams with the ewes for seven weeks in case any ewe should come into season a second time. For a good percentage a second mating is sometimes necessary. Join 2 per cent. of two-tooth, four-tooth, six tooth, and eight-tooth rams, or 3 per cent. of older rams with the flock; with fine-woolled Merino rams 3 per cent. of two-tooths is advisable. Rams should be in good condition. Pare their feet and clean wool and burrs from around eyes and pizzles before joining.

Breeding ewes should be of one breed or cross, and should be culled, so that the wool of the progeny will be as even in quality as possible. This precaution would also ensure an even dropping of lambs. Merinos and fine-woolled ewes come into season first; half-bred and strong-woolled crosses later; all sheep with a preponderance of British blood are even later still. It is useless to join rams with ewes until their proper time for coming into season. Rams may be active, but ewes will not conceive until in season.

Preparation should be made for dipping, and this important operation must be carried out. Mix dip thoroughly and in the manner indicated in directions. Be sure the sheep are not over-heated when dipped. If possible, dipping should not be done during hot weather.

Poultry.—The young growing stock should be given as much free range as possible. Good rearing means stronger birds and thus less sickness and more eggs next winter. Supply plenty of green feed at this time. One-third of the morning mash should consist of green feed, and it should also be given after the grain feed at night. Sow maize or millet to provide green stuff for the late summer and early autumn. Top off geese, ducks and cockerels for the Christmas market, but do not wait for the last sale before Christmas, as it is usually overstocked and prices are reduced. Vermin multiply very rapidly during the warm weather, so perches and nests should be disinfected regularly. Provide the birds with a good dustbath of sand, ashes, &c., and moisten same. This will enable them to keep themselves cool and clean. Remove all males from the flock, as infertile eggs will keep much better, especially during the hot weather. The male bird is not necessary in the laying pen. Eggs should be gathered twice a day.

BEE-KEEPING.

December is the month for the main honey flow from yellow box and red gum Swarming is practically over for the season except, perhaps, in late districts Where there has been more swarming than the owner of the bees desired, and the total yield of honey is the object aimed at rather than increase in the number of colonies, the weaker stocks may be united at the commencement of the honey flow, as the highest return is secured by having a given number of bees in the fewest possible number of hives; that is to say, 50,000 worker bees in one hive will store a far greater amount of honey than the same number in two hives with 25,000 bees in each. Such a large worker-force requires three bodies of full-depth frames, otherwise the best results cannot be obtained, because nectar being as thin as water when brought in by the bees, only a little is put into each cell to hasten evaporation. When, therefore, sufficient empty combs are not available to the bees, part of the worker-force will be idle.

Each colony should have at least three sets of Langstroth size combs, and when these are not available the time of the red gum honey flow is suitable for getting new combs drawn out from full sheets of foundation. Comb foundation is expensive, but in the end combs built from starters are more expensive still, because so much drone comb is built when starters only are given, that one of the principal advantages of the frame-hive system is lost.

All frames should be wired, four horizontal wires being most in favour with beekeepers; the wires should be well embedded into the foundation so that it may not come away from them. Between the bottom edge of the sheet of foundation and the bottom bar of the frame there should be a space of at least 5-16 inch, to allow for the expansion of the sheet by the heat of the hive.

The best combs are obtained when the foundation is drawn out by the bees in the super immediately over the brood nest without an intervening excluder.

Combs should be capped at least two-thirds before being extracted, so that the honey will be of good density. When hives are run three stories high, as indicated above, there is no necessity to extract all the honey at one time; one set of combs can be extracted, and the empty combs returned to the hive, and when they are partly filled again the others can be taken. In this way the bees are not upset so much as when all the combs are wet and sticky after extracting, and the risk of leaving the hive destitute of stores is avoided should the honey flow suddenly cease.

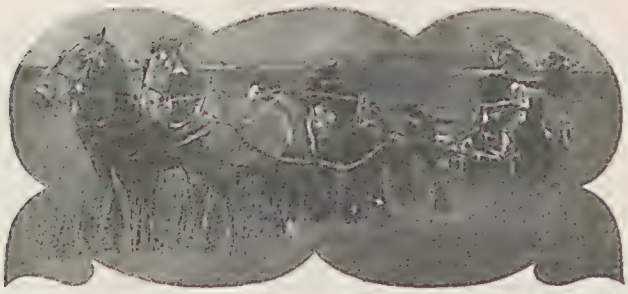
CULTIVATION.

Farm.—Cut hay in late districts. Cut oats and barley in early places. Finish planting potatoes. Put in late maize for fodder, also millet and imphee. Plough fire-breaks where required. Get stackyard and stages ready for hay.

Orchard.—Keep the surface loose and free. Suppress weeds. Spray as often as necessary for codlin moth and pear slug. Mulch and spray young trees and grafts with water in the early morning during hot weather.

Vegetable Garden.—Keep the surface hoed, and allow the plants plenty of moisture. Stake, pinch out, manure, and water tomatoes. Pinch back long runners of pumpkin and melon family. Sow autumn and winter varieties of cabbage and cauliflower. Plant out seedlings in cool weather. Sow French beans. Cease cutting asparagus beds, and top-dress with manure.

Flower Garden.—Plant out dahlias and gladioli for autumn blooming. Lift and store spring flowering bulbs. Stake, tie, and train growing plants. Sow zinnias and asters. Layer carnations, camelias, daphnes, &c. Water well and keep the surface loose. Keep rose beds fairly dry.



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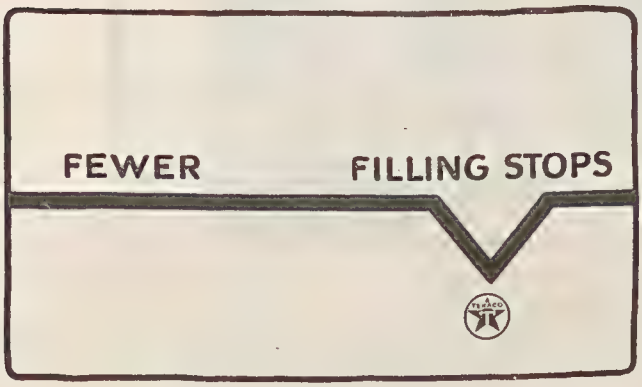

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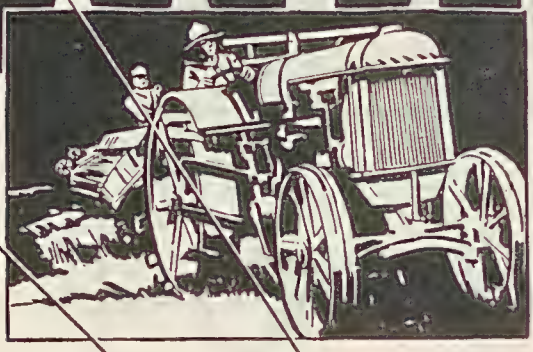

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